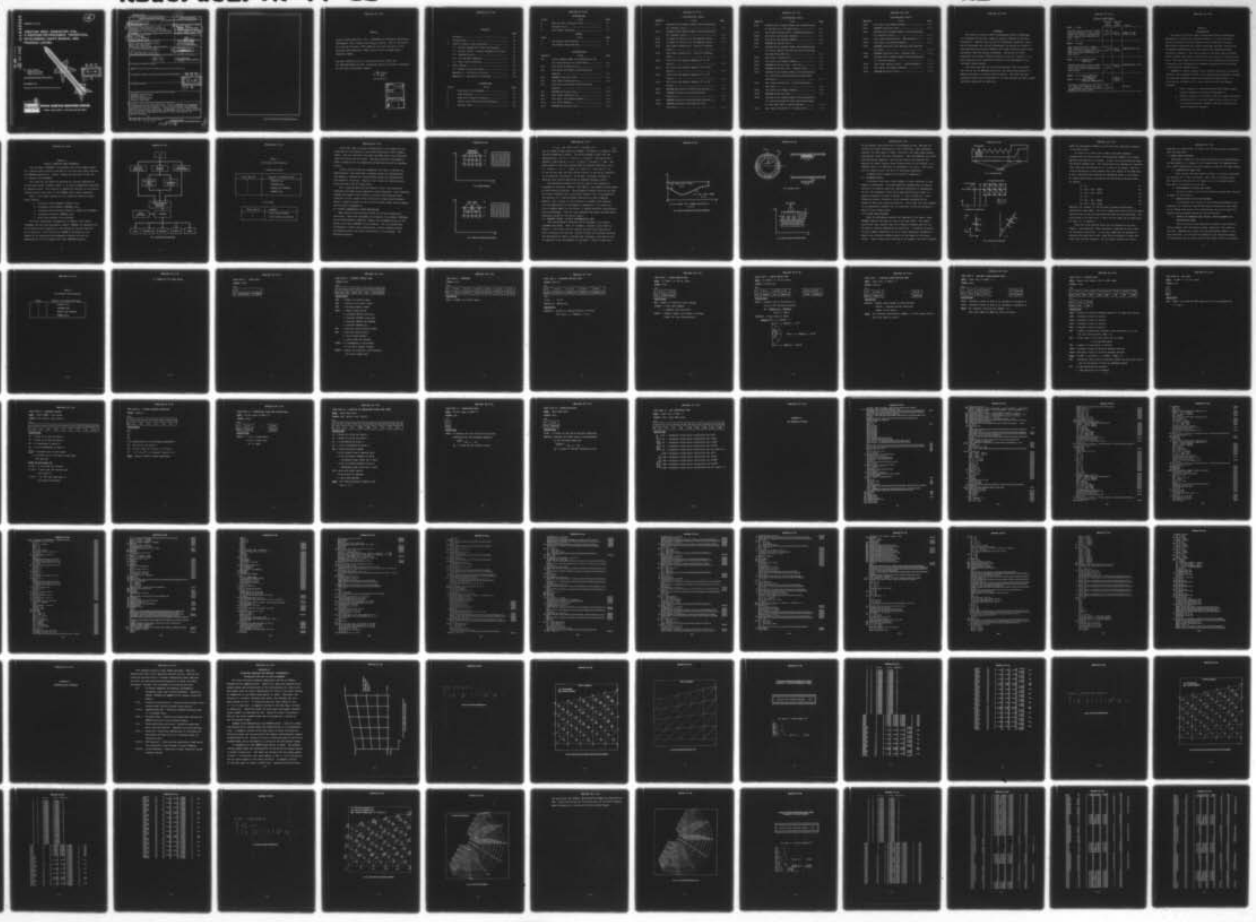
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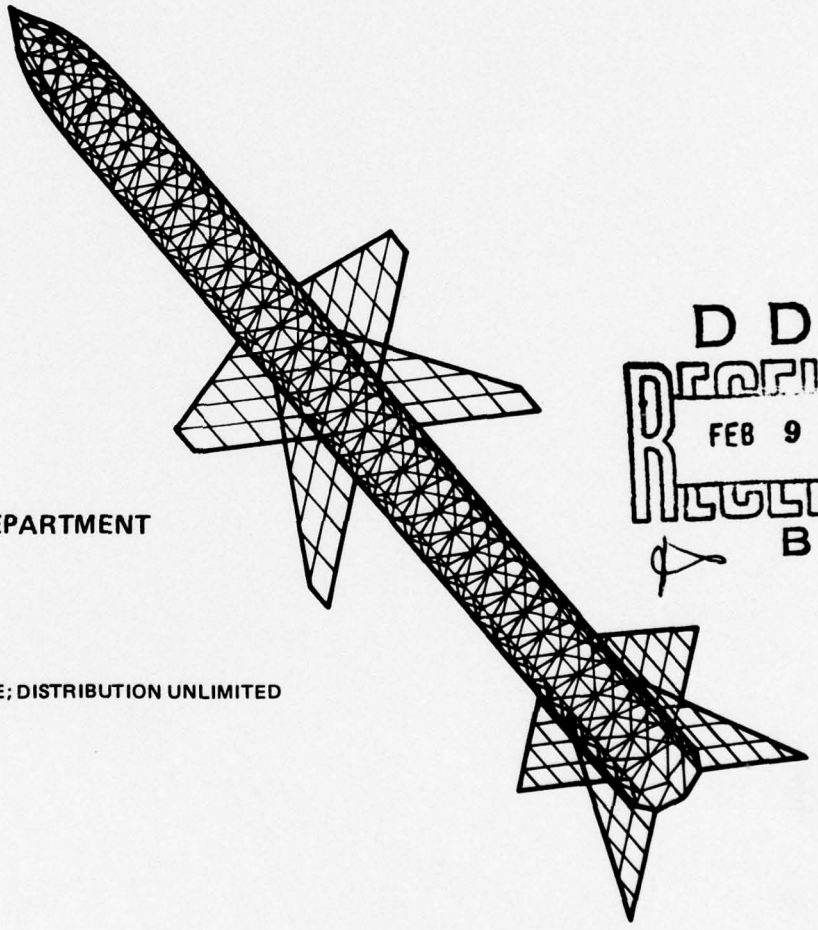
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BY PAO C. HUANG
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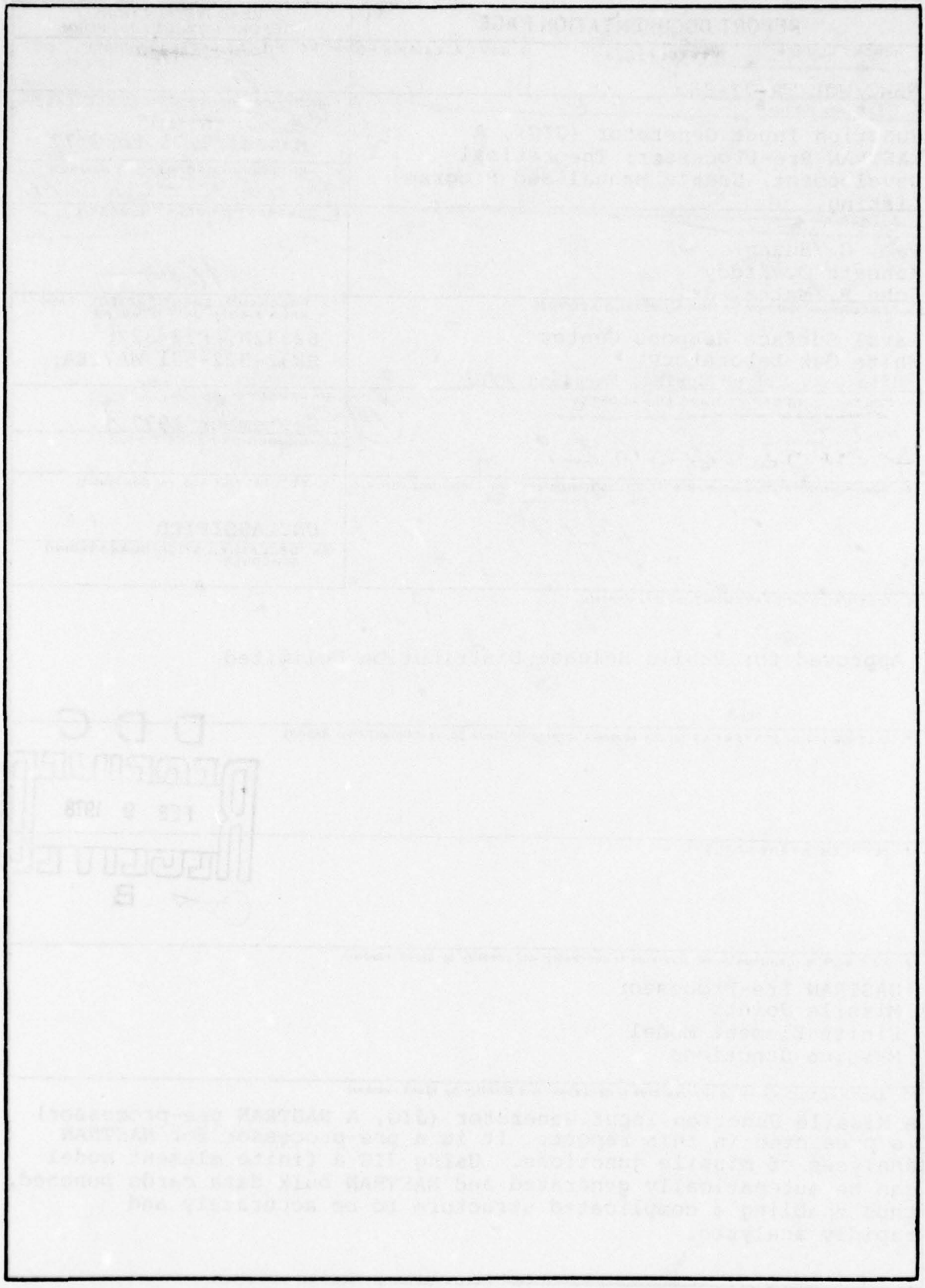
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A Missile Junction Input Generator (JIG, A NASTRAN pre-processor) is presented in this report. It is a pre-processor for NASTRAN analyses of missile junctions. Using JIG a finite element model can be automatically generated and NASTRAN bulk data cards punched, thus enabling a complicated structure to be accurately and rapidly analyzed.

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PREFACE

Junction Input-Generator (JIG), A NASTRAN Pre-Processor; Theoretical Development, User's Manual and Program Listing. This is the fourth of a series of Project LIMIT Reports; the first two were on the Planform Input Generator (PING) and the third the Body Input Generator (BING).

The work reported herein is being carried out under task No. SEA-18452/SF32-322-501, Lightweight Missile Structure, sponsored by the Naval Sea Systems Command.

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FOREWORD

The object of Project LIMIT (Lightweight Missile Technology) is to develop and provide computer analysis methods for missile structures. Together with the use of lightweight materials, fabrication techniques and related technology, the design of a missile with optimized structural elements can be made practical from a computational time and expense standpoint. The merits of these techniques will permit different missile structural concepts to be both thoroughly and repeatedly analyzed in the development of an efficient weapon system.

This work develops the third pre-processor code to increase the utility of the NASTRAN program for the design and analysis of massive junctions in missile body structure. The first two pre-processors which can be employed for lifting surfaces and shell bodies have been completed and reported.

Project LIMIT Report

	Development Period	Computer Code Statue	Report
PHASE - I PING Planform input generator (PING) Program develops finite element models for missile lifting surfaces and punches NASTRAN bulk data cards.	July 71 to June 73	Operational	NOLTR 73-199 NOLTR 73-228
PHASE - II BING Body input generator (BING) Program develops finite element models for axi-symmetrical shell body and punches NASTRAN bulk data cards.	July 73 to June 75	Operational	NSWC/WOL/TR 75-9
PHASE - III A MASSIVE JOINT JUNCTIONS Program develops finite element models for massive joint junctions and punches NASTRAN bulk data cards.	July 75 to Aug 77	Operational	NSWC/WOL/TR 77-85
PHASE - III B AERO-ELASTICITY INTERACTION PHASE - III C AERO-DYNAMIC HEATING INTERACTION Programs automatically calculate air loads and temperatures due to aerodynamic heating and punch NASTRAN bulk data cards.	Aug 77 to June 81	Under Development	Future

Chapter I

INTRODUCTION

The object of Project LIMIT (Lightweight Missile Technology), sponsored by the Naval Sea Systems Command, is to provide modern structural analysis methods together with lightweight materials, fabrication techniques and related technology whereby a missile may be designed economically and efficiently with weight-optimized structural elements. The current phase of the work aims to promote finite element techniques in the design and analysis of missile structure. The great speed and precision of these techniques would permit a missile to be thoroughly and repeatedly analyzed and thus provide a more efficient weapon system.

NASTRAN, a general purpose finite element program for structural analysis, was developed by NASA and is gaining wide acceptance through the technical community especially among Naval Laboratories. It is versatile and applies to a large class of static and dynamic problems:

a. Static response to concentrated and distributed loads, thermal expansion and enforced deformation .
b. Dynamic response to transient loads and random excitation.
c. Determination of real and complex eigen values for use in vibration analysis, dynamic stability analysis and elastic stability analysis.

However, to prepare NASTRAN input for a complicated problem is a large effort in itself. It includes the layout of grid mesh; calculation of grid point locations; element properties and their connections to grid points; preparation of input sheets; and, finally, punching of input cards. All this work is extremely time consuming and requires a team of specialists. Furthermore, possible occurrences of human errors together with unavoidable redesign cycles would make the analysis formidable. To remedy these difficulties, special input generation programs are being developed to automatically generate finite element models and the associated NASTRAN input for missile structures. This work will be completed in three phases. In the initial phase a pre-processor has been completed for lifting surfaces; the work was published in NOLTR 73-199, entitled "Planform Input Generator (PING), a NASTRAN Pre-processor for Lifting Surfaces - Theoretical Development, User's Manual, and Program Listing" December 1973. The second phase has concluded with a report entitled "Missile Body Input Generator (BING), A NASTRAN Pre-processor, Theoretical Development, User's Manual, and Program Listing". This report was published as a NSWC/WOL/TR 75-9 in March 1975.

The third phase, concerned with massive bodies and junctions in missile structure, is documented in this report. These three pre-processors together can supply most of the bulk data cards for a NASTRAN analysis of a complete missile structure.

This Junction Input Generator, designated as JIG, can rapidly develop a finite element model and NASTRAN bulk data cards for any massive body such as a joint or nozzle for elaborate structural analysis. Chapter 2 discusses the background of the program and its applications.

Chapter 3 presents the user's manual. Appendix A lists the complete program. Appendix B presents example problems with complete input procedure and NASTRAN bulk data listings.

Chapter 2

MISSILE JUNCTION INPUT GENERATOR

JIG, written in FORTRAN, can generate the finite element model for a massive shell junction and most of the bulk data cards required for NASTRAN application. Figure 1 shows the functions of JIG and its relation with NASTRAN.

This code has the option of punching out various combinations of bulk data cards, listed in Table 1, to avoid accumulating thousands of unwanted cards. This feature is especially feasible in the design - redesign cycles where most of the NASTRAN input remain unchanged.

Table 1 lists punch options for the connection and grid cards,. These include:

a. Triangular Plate Element (CTRIA2) only.

b. Triangular Ring Element (CTRIARG) only.

c. Triangular Ring and Plate Elements (CTRIA2 and CTRIARG).

d. Polyhedron Elements (CWEDGE) only.

e. Grid cards punched or not punched.

The three dimensional axisymmetric triangular ring element (CTRIARG) and the solid polyhedron element (CWEDGE) are employed here as the basic finite elements for the anlyses of massive body and joint structure. The inclusion of CWEDGE is provided for the capability of analyzing non-axisymmetric bodies and also the compatibility of this element with other NASTRAN elements.

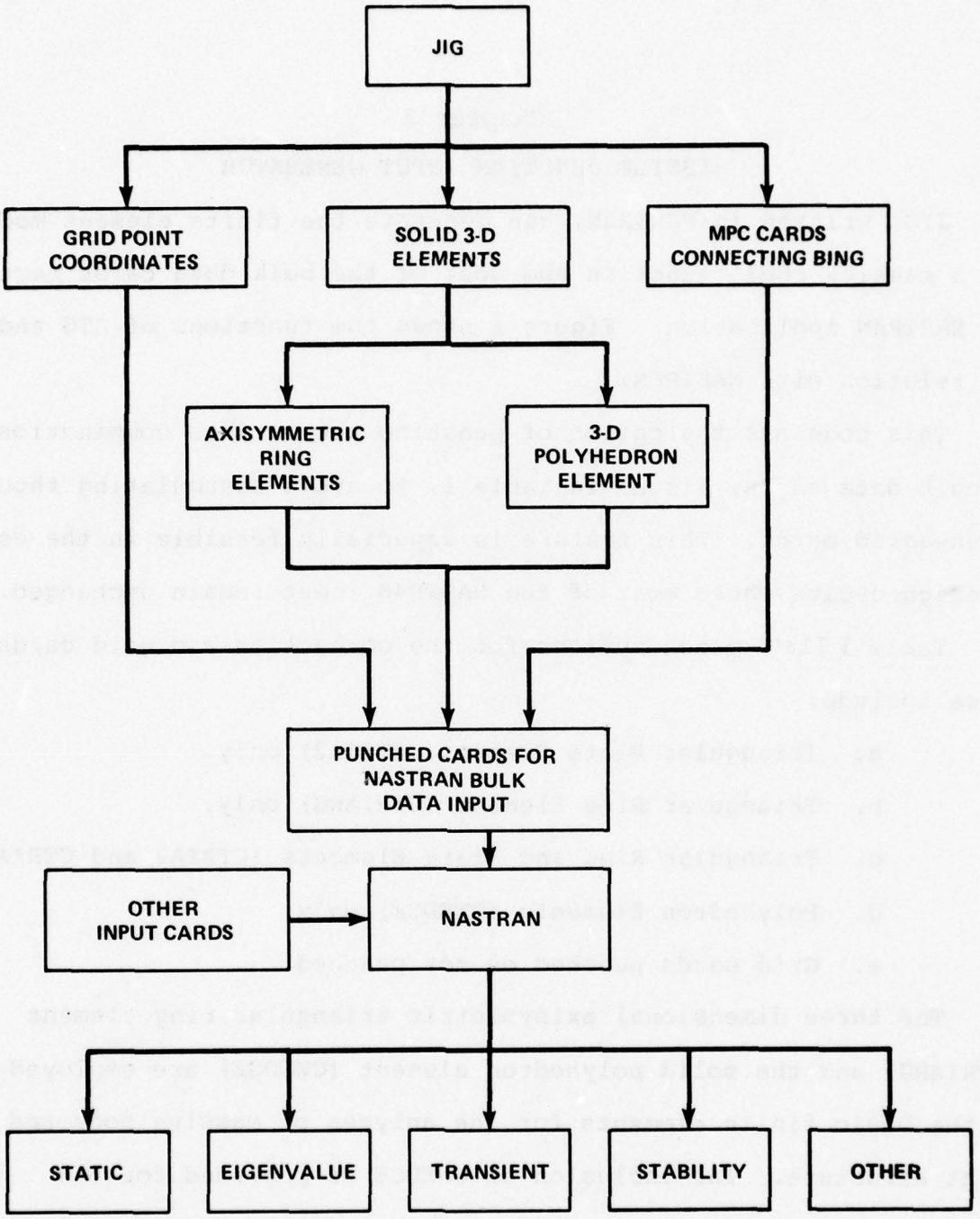


FIG. 1 FUNCTIONS OF JIG/NASTRAN

Table 1

JIG Output Punch Options

Connection Cards

Punch Options	Type(s) of Element Cards
0	CTRIA2 only
1	CTRIARG only
2	CTRIA2 and CTRIARG
3	CWEDGE only

Grid Cards

Punch Option	Comment
0	grid cards punched
1	grid cards not punched

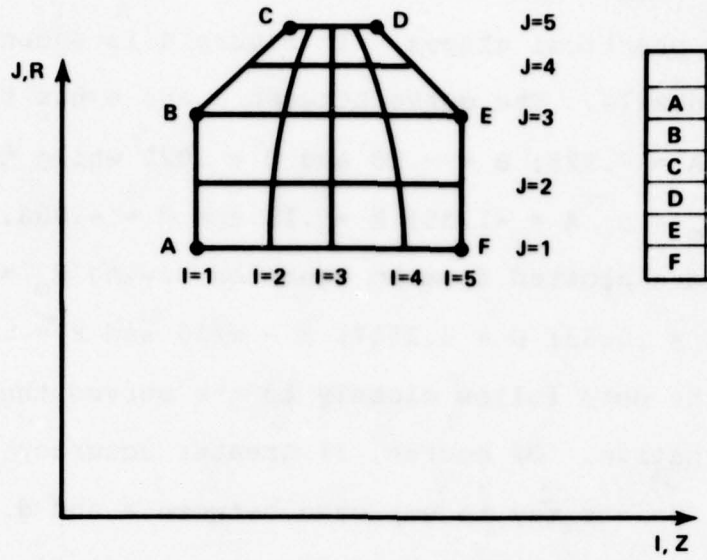
Using JIG, only a typical configuration in R-Z plane will be required for the creation of the three-dimensional finite element model. JIG will calculate and punch the GRID and/or the connection cards for the entire structure. The same subroutine developed in PING is adopted here for computing the mesh points and the boundary points.

Control points along the boundaries are input to define the configuration, then additional boundary points are calculated by the program. Finally the internal mesh points are calculated by the method of iteration. Figures 2 and 3 show the control points A,B,C,D,E and F and the mesh points.

For a tapering mesh such as Figures 2 and 3 the transition technique from PING can be applied to great advantage. This technique reduces the number of mesh points in the narrower sections thus yielding a finite element model with better proportioned elements. Figure 3 shows the mesh of such a finite element model and an example can be found in Appendix B.

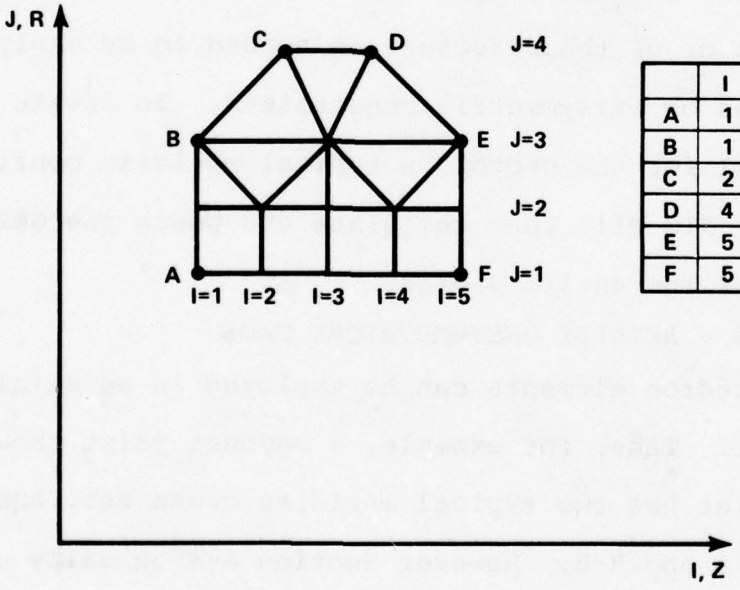
2.1 AXIALLY SYMMETRICAL JOINTS AND NOZZLES

Most massive junctions and nozzles are axially symmetrical structures. Hence the axisymmetric triangular ring element (CTRIARG) can be advantageously employed, despite the incompatibility of this element with other NASTRAN finite elements. For the convenience of modeling a nozzle type configuration, curved boundary between two boundary points has been incorporated in this program. The following equation



	I	J	R	Z
A	1	1	6	3
B	1	3	9	3
C	1	5	11	5
D	5	5	11	7
E	5	3	9	9
F	5	1	6	9

FIG. 2 MESH PLANNING



	I	J	R	Z
A	1	1	6	3
B	1	3	9	3
C	2	4	11	5
D	4	4	11	7
E	5	3	9	9
F	5	1	6	9

FIG. 3 MESH WITH TRANSITION FEATURE

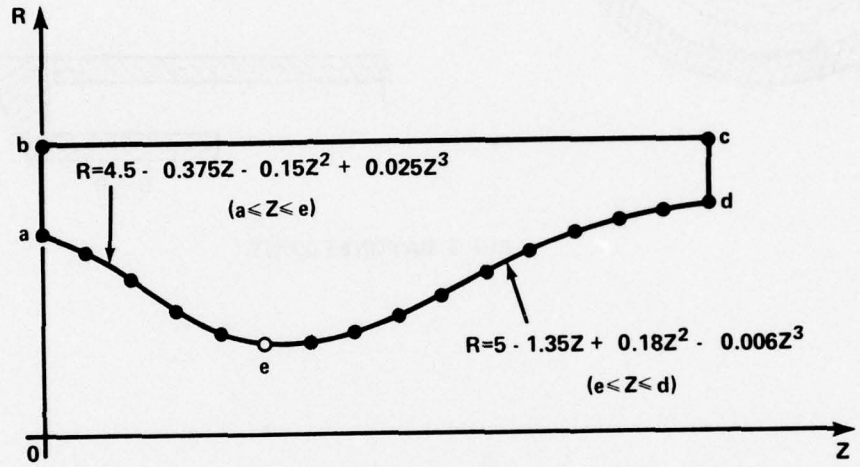
$$R = R_o + AZ + BZ^2 + CZ^3 + D\cos(EZ + F) \quad (1)$$

can be fitted to many practical shapes. In Figure 4 is shown a cross section resembling a nozzle. The curve between a and e has the parameters R_o = 4.5; A = -.375; B = -.15 and C = .025 while that between e and d has R_o = 5; A = -1.35; B = .18 and C = -.006. The dots between a and d are plotted from an equation having R_o = 4.5; A = .5676; B = -.1; C = .0033; D = 3.2517; E - $\pi/10$ and F = .5π. It can be seen that the dots follow closely to the curves therefore is an excellent alternative. Of course, if greater accuracy is desired, more control points may be employed between a and d.

The polyhedron element can also be used in the analysis of axisymmetric problems. However, the simpler ring element should always be used whenever possible. The polyhedron element which can be used with other elements such as the plate element, etc. is provided for the analysis of a junction model consisting of shell segments. However, only a sector of the structure is needed to be analyzed with the application of axisymmetric constraints. To create the finite element model for the sector, a typical meridian configuration must be developed. JIG will then calculate and punch the GRID and/or connection cards for the entire sector.

2.2 BAYONET JOINTS - AXIALLY UNSYMMETRICAL CASE

Only the polyhedron elements can be employed in an axially unsymmetrical model. Take, for example, a bayonet joint shown in Figure 5. This joint has two typical meridian cross sections as seen in Sections A-A and B-B. However Section A-A actually contains the configuration shown in Section B-B, therefore, only Section A-A is required in the development of the model. Figure 6 shows part



● R=4.5 + 0.5676Z - 0.1Z^2 + 0.0033Z^3 - 3.2517 SIN π/10 Z
(a≤Z≤d)

FIG. 4 NOZZLE CROSS SECTION, CURVED BOUNDARY

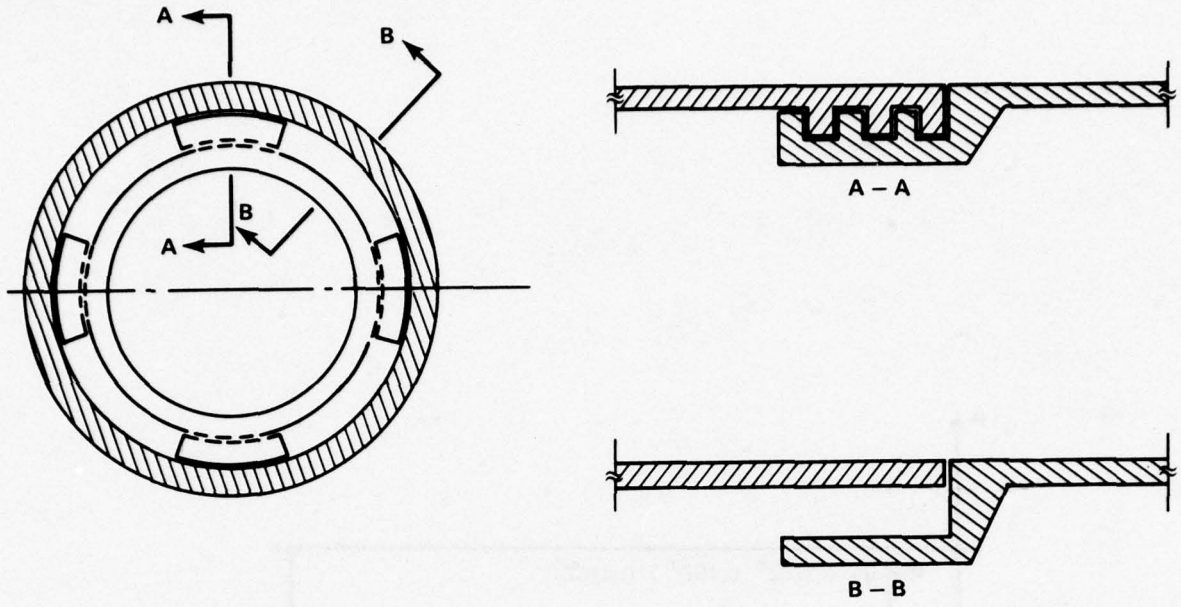


FIG. 5 BAYONET JOINT

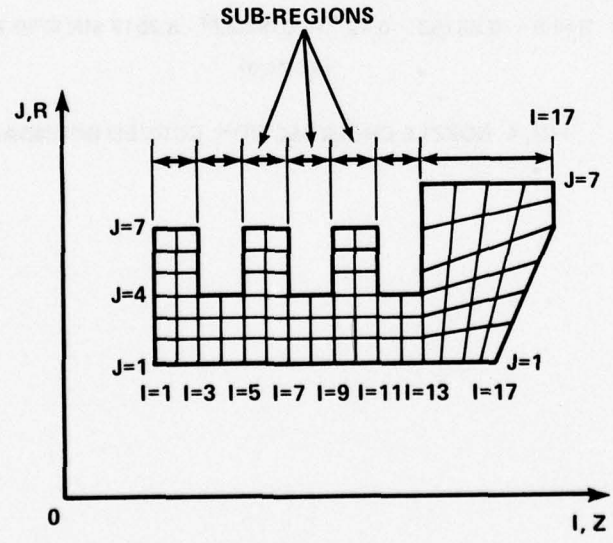


FIG. 6 MESH OF PART OF BAYONET JOINT

of the bayonet joint which will be developed by JIG. The mesh is divided into seven subregions in the Z direction. Each subregion requires the same types of input, therefore, the input cards become increasingly bulky with more subregions. JIG will generate the sector that Section A-A applies. For the next sector that Section B-B applies JIG simply ignores those elements which do not belong, i.e., elements from J = 4 and above in subregions 1,2, and 3. This cycle will be repeated until the joint is developed completely.

A demonstrative example can be found in Appendix B.

2.3 THREADED JOINTS

A threaded joint has a large number of teeth therefore a large number of subregions. To avoid inputting repeated data, a special provision to simplify input for repeated subregions is implemented so that the subsequent teeth can be generated from the input of a typical subregion as shown in Figure 7. This is done by a transformation process, therefore, every repeated subregion has an identical mesh with unique grid points. Then either the ring elements or the polyhedron elements will be connected to the grid points to form a finite element model.

2.4 JIG AND BING COUPLING

When the polyhedron elements are employed in the model, other NASTRAN elements can also be used in the same model. The common grid points that connect these two different elements must be constrained to achieve compatibility conditions. In missile structure the most common combination is the triaxial polyhedron elements together with the plate elements which are developed on thin plate theory. Take a shell-joint junction as an example, the finite element

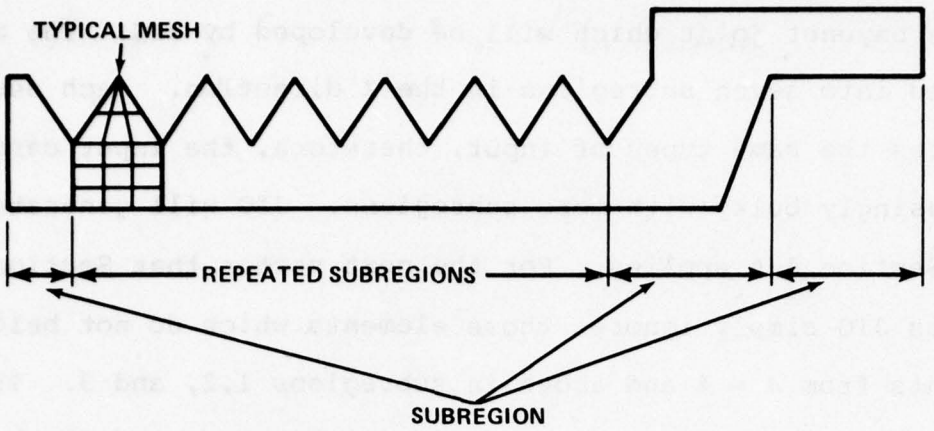
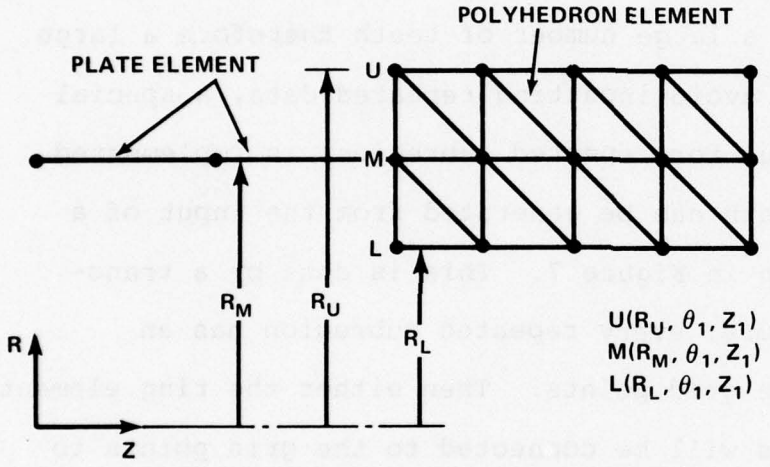


FIG. 7 THREADED JOINT



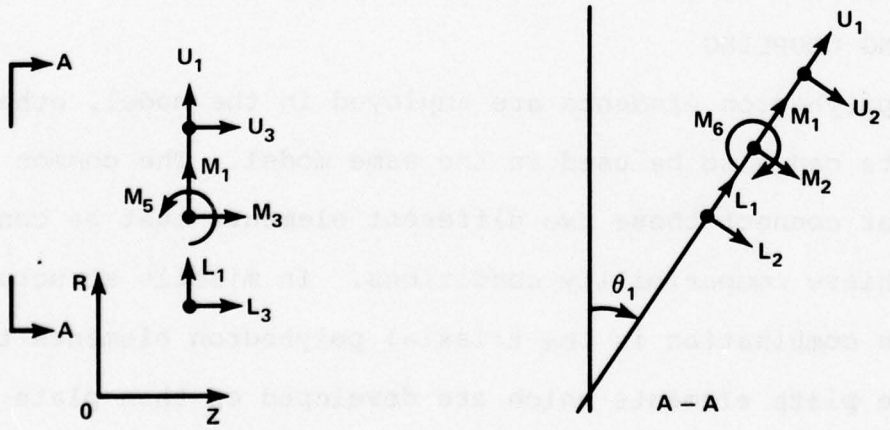


FIG. 8 JOINT-SHELL INTERFACE

model has polyhedron elements in the thick part and plate elements in the shell areas.

In Figure 8 is shown such a model, the plate elements representing the shell connect the polyhedron elements at a radius R_M where grid point M is located. U and L are the grid points above and below M respectively. All three points are located on a junction line along the intersection of $\theta = \theta_1$ and $Z = Z_1$ planes. The grid point M connecting a plate element has five degrees of freedom while U and L have only three degrees of freedom as shown in the figure. To insure shell-joint interactions the following constraints must be imposed.

$$U_1 = M_1 \tag{2}$$

$$U_2 = M_2 + (R_U - T_M)M_6 \tag{3}$$

$$U_3 = M_3 + (R_M - R_U)M_5 \tag{4}$$

$$L_1 = M_1 \tag{5}$$

$$L_2 = M_2 + (R_L - R_M)M_6 \tag{6}$$

$$L_3 = M_3 + (R_M - R_L)M_5 \tag{7}$$

Equation (2) through (7) can be input by means of Multipoint Constraints Cards (MPC). For every common grid point M JIG will automatically set up the six equations and punch out the MPC cards. The grid points to be used as M, L and U are JIG input and are specified by their (I, J) location.

There are three options which can be selected by the user; namely: left coupling, right coupling or couplings on both sides of the massive structure. In any case, BING must be employed to generate the shell part first, then JIG can proceed to create the joint part and the coupling. The grid point numbers of M where

couplings are desired must be input into the JIG and can be obtained from the BING model.

2.5 OTHER USEFUL FEATURES

Developed in BING are the following features which make possible the development of a complex finite element model for NASTRAN analysis. These capabilities are also retained in JIG for the same reason.

1. TRANSITION OF MESH SIZE

This feature has been shown in Figure 3 in which transitions are carried out in the J direction. The I and J directions must be oriented as indicated in the figure, i.e., I is directed along Z axis and J is directed in the R axis.

2. DISPLACEMENT OF POINTS AND LINES

Any points and/or lines can be placed at prescribed locations by means of this feature.

3. PRESCRIPTION OF GRID POINT NUMBER

To facilitate the joining of two structural components and eliminate the otherwise required Multipoint Constraints Cards (MPC) at the common grid points, this preprocessor has the provision for inputting pre-assigned numbers for any grid points.

4. CONTROL OF NUMBERING GRID POINTS, FINITE ELEMENTS AND CONTINUATION CARDS

This provision avoids duplication numbers in grid points, finite elements and continuation cards, especially with separate JIG runs. NASTRAN will reject any such duplicated numbers in the bulk data deck. To provide this capability the beginning numbers of these cards must be input and the last number used are tabulated

in the output of a JIG run so that in the subsequent run, proper beginning numbers can be selected.

Chapter 3

USER'S MANUAL

JIG, written in FORTRAN, can generate the finite element model of a joint type junction and most of the bulk data cards required for NASTRAN application. This code is capable of generating an axisymmetric triangular cross section ring element (CTRIAG) or a three-dimensional solid, with three quadrilateral faces and two opposing triangular faces, (CWEDGE). The triangular membrane and bending element (CTRIA2) can also be generated for a two-dimensional problem. Table 2 list the different element punch options available.

This section presents card formats in sequential order which must be followed exactly when preparing the JIG input. There are 18 card types altogether, however, the number of card types to be used will vary depending on the type of problem encountered. The user should start from card type 1 and proceed through 19. Any card types to be omitted or put in more than once will be identified in the instruction.

Table 2

JIG Element Punch Options

Punch	Type(s) of Connection Cards
0	CTRIA2 only
1	CTRIARG only
2	CTRIA2 and CTRIARG
3	CWEDGE only

3-1 FORMAT OF JIG CARD TYPES

CARD TYPE 1 - TITLE CARD

FORMAT (13A6)

Col.

1-78
ANY ALPHANUMERIC STATEMENT

CARD TYPE 2 - PROGRAM CONTROL CARD

FORMAT (8I5)

Col.

1-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40
NST	NGS	NES	NPOP	MID	NGP	IDELT	NSECT

DEFINITIONS

NST = number of section types

NGS = starting grid point number

NES = starting element number

NPOP = element punch option

= 0 punches CTR1A2 cards only

= 1 punches CTR1ARG cards only

= 2 punches CTR1A2 and CTR1ARG

= 3 punches CWEDGE only

MID = material identification number

NGP = grid card punch option

= 0 grid cards punched

= 1 grid cards not punched

IDELT = 0 axisymmetric ring element

= 1 3-D solid (wedge) element

NSECT = number of different cross-sections

(for solid wedge only)

CARD TYPE 3 - REPEATED

FORMAT (715)

Col.

1-5	6-10	11-15	16-20	21-25	26-30	31-35
NT(I)	NT(I+1)	NT(I+2)	NT(I+3)	NT(I+4)	NT(I+5)	NT(I+6)

DEFINITION

NT(I) = number of section type I

CARD TYPE 4 - REPEATED SECTION DATA

FORMAT (7F10.4)

Col.

1-10	11-20	21-30	31-40	41-50
DELTZ(1)	DELTZ(I+1)	DELTZ(I+2)	DELTZ(I+3)	DELTZ(I+4)

Col.

51-60 61-70

DELTZ(I+5) DELTZ(I+6)

DEFINITION

DELTZ(I) = length of repeated section (Z-value)

(for NT(I) = 1, DELTZ(I) = 0.0)

CARD TYPE 5 - THETA REGION DATA

NOTE: If IDELT = 0, do not input

FORMAT (315)

Col.

1-5	6-10	11-15
NDT	ICLOSE	DELGP

DEFINITIONS

NDT = number of different theta regions

ICLOSE = 0 full 360^{o} segment

= 1 segment less than 360^{o}

DELGP = element number to be added to orginal number for each theta section

CARD TYPE 6 - THETA REGION DATA

NOTE: If IDELT = 0, do not input

FORMAT (5(I5,F10.4))

Col.

1-5	6-15	16-20	21-30		...		61-65	66-75
KK(1)	THETA(1)	KK(2)	THETA(2)				KK(N)	THETA(N)

DEFINITIONS

KK(N) = integer used to determine $\Delta\theta$,

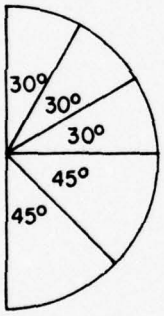
used in the following equation

$$\Delta\theta = \frac{\text{THETA(I+1) - THETA(I)}}{\text{KK(I+1) - KK(I)}}$$

THETA(N) = theta value at KK(N)

Example NDT = 2, ICLOSE = 1

KK(1) = 1, THETA(1) = 0.0°



KK(2) = 4, THETA(2) = 90.0°

KK(3) = 6, THETA(3) = 180.0°

CARD TYPE 7 - VARIABLE CROSS-SECTION DATA

NOTE: Input only if IDELT = 1

FORMAT (7F10.4)

Col.

1-10	11-20		...		61-70
BETA(1)	BETA(2)				BETA(N)

DEFINITION

BETA(N) - angles where change of cross-section occurs, (include initial and final angles of the joint)

NOTE: For constant cross-section (NSECT = 1) only input initial and final angle of joint.

CARD TYPE 8 - VARIABLE CROSS-SECTION DATA

NOTE: Input only if IDELT = 1.

FORMAT (815)

Col.

1-5	6-10	11-15	16-20		...		31-35	36-40
JB(1)	JE(1)	JB(2)	JE(2)				JB(N)	JE(N)

DEFINITIONS

JB(N) - minimum J-value of mesh to be included in subsector N

JE(N) - maximum J-value of mesh to be included in subsector N

NOTE: For constant cross-section (NSECT = 1),
only input JMIN and JMAX for JB(1) and JE(1).

CARD TYPE 9 - SECTION DATA

NOTE: Repeat card types 9 thru 15 NST times.

FORMAT (12I5)

Col.

1-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45
NEBP	JMIN	JMAX	MINI	MAXI	NHO	NPO	NTR	JMINJ

Col.

46-50	51-55	56-60
JMAXJ	NPS	MPC

DEFINITIONS

NEBP = number of external boundary points to be input for section

JMIN = minimum J-value of section

JMAX = maximum J-value of section

MINI = mimimum I-value of section

MAXI = maximum I-value of section

NHO = number of prescribed internal lines and points (i.e., for one line and one point, NHO = 2)

NPO = tooth code = 0 for flat tooth (or no tooth)
= 1 for pointed tooth

NTR = number of transitions in section

JMINJ = minimum J-value of junction between sections

JMAXJ = maximum J-value of junction between sections

NOTE: If NST = 1 and NT(1) = 1, JMINJ = JMAXJ = 0

NPS = permanent single point constraint associated with grid points (any of the digits 1-6 with no imbedded blanks)

MPC = 0 MPC equations not punched
= 1 MPC equations to be punched

CARD TYPE 10 - MPC DATA

NOTE: If MPC = 0, do not input.

FORMAT (I5)

Col.
1-5
NBO

DEFINITION

NBO = number of boundaries MPC equations are to be punched for

(= 1 or 2)

CARD TYPE 11 - MPC DATA

NOTE: Input NBO cards (do not input if MPC = 0)

FORMAT (9I5)

Col.

1-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45
IU(M)	JU(M)	MI(M)	JM(M)	IL(M)	LJ(M)	LS(M)	ICONST(M)	JCONST(M)

DEFINITIONS

IU(M), JU(M) = I, J Location of upper grid point in MPC equation

MI(M), JM(M) = I, J Location of middle grid point in MPC equation

IL(M), LJ(M) = I, J Location of lower grid point in MPC equation

LS(M) = Repeated section number for which the MPC equations are to be written (i.e., first or last; = 1 if section is not repeated)

ICONST(M)
JCONST(M) } = constant I or J for line of points given above (only one gets a value, the other is 0)

CARD TYPE 12 - TOOTH POINT DATA

NOTE: Do not input if NPO = 0

FORMAT (I5, 2F10.5)

Col.

1-5	6-15	16-25
JP	ZP	XP

DEFINITIONS

JP = J-value of tooth point (=JMAX + 1)

ZP = Z-value of tooth point

XP = X- or R-value of tooth point

CARD TYPE 13 - BOUNDARY POINTS

NOTE: Input (NEBP + 1)/2 cards

FORMAT (2I5, 2F10.5, 2I5, 2F10.5)

Col.

1-5	6-10	11-20	21-30	31-35	36-40	41-45	46-55	56-65	66-70
I1	J1	Z1	X1	IC1	I2	J2	Z2	X2	IC2

DEFINITIONS

In = value of I-line for point n

Jn = value of J-line for point n

Zn = Z coordinate of point n

Xn = X or R coordinate of point n

IC1, IC2 = 1 straight line to next point

= 2 curved line to next point; card type 11A required

Order of card type 11A

If IC1 = 2 card type 11A follows

If IC2 = 2 card type 11A follows next card type 11

If IC2 = 2 in the last card type 11, card type 11A follows

CARD TYPE 14 - CURVED BOUNDARY EQUATION

FORMAT (7F10.4)

Col.

1-10	11-20	21-30	31-40	41-50	51-60	61-70
RO	A	B	C	D	E	F

DEFINITIONS

RO, A, B, C, D, E, F = Coefficients in the boundary expression for X(I,J) (or R(I,J))

$$X(I,J) = RO + A * Z(I,J) + B * Z(I,J) + C * Z(I,J)^3 + D * \cos(E * Z(I,J) + F)$$

NOTE: Actual Z used in above expression

CARD TYPE 15 - PRESCRIBED LINES AND POINTS DATA

NOTE: Do not input if NHO = 0

FORMAT (10I5)

Col.

1-5	6-10		...		46-50
NPH(1)	NPH(2)				NPH(N)

DEFINITIONS

NPH(N) = 1 for a fixed point

= 2 for a fixed line

(N = 1, NHO)

CARD TYPE 16 - LOCATION OF PRESCRIBED POINTS AND LINES

NOTE: Input NHO cards

FORMAT (2I5, 2F10.5, 4I5, 2F10.5)

Col.

1-5	6-10	11-20	21-30	31-35	36-40	41-45	46-50	51-60	61-70
I1	J1	Z1	X1	NG1	IPO	I2	J2	Z2	X2

DEFINITIONS

In = value of I-line for point n

Jn = value of J-line for point n

Zn = Z coordinate of point n

Xn = X or R coordinate of point n

NG1 = fixed grid point number

= 0 for fixed Z and X location only

> 0 for grid point numbers to go in increasing order (only for a line)

< 0 for grid point numbers to go in decreasing order (only for a line)

IPO = grid card punch option

= 0 grid card not punched

= 1 grid card punched

NOTE: For fixed grid point numbers only set X < 0.0

CARD TYPE 17 - TRANSITION DATA

NOTE: Do not input if NTR = 0

FORMAT (I5)

Col.
1-5
INTN

DEFINITION

INTN = a constant for the initial J-line to be determined by the following equation

$$2^{INTN} = I_{N+1} - I_N$$

I_N = I-value of the initial J-line

CARD TYPE 18 - TRANSITION DATA

NOTE: Input NTR cards

FORMAT (2I5)

Col.

1-5	6-10
JT(N)	NTNT(N)

DEFINITIONS

JT(N) = J-value at the end of the Nth transition

NTNT(N) = constant for JT(N) line to be determined by the following equation:

$$2^{NTNT(I)} = I_{N+1} - I_N$$

I_N = I-value of the Nth transition line

CARD TYPE 19 - MPC CONSTRAINT DATA

NOTE: Input only if MPC = 1

FORMAT (10I5) Input NBO cards.

Col.

1-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50
CZ	CN	CO	CT	CB	CZM	CNM	COM	CTM	CBM

DEFINITIONS

upper and lower grid points

- CZ = Permanent single point constraints for $\theta=0^{\circ}$
- CN = Permanent single point constraints for $\theta=90^{\circ}$
- CO = Permanent single point constraints for $\theta=180^{\circ}$
- CT = Permanent single point constraints for $\theta=270^{\circ}$
- CB = Permanent single point constraints for all other 0's

middle grid points

- CZM = Permanent single point constraints for $\theta=0^{\circ}$
- CNM = Permanent single point constraints for $\theta=90^{\circ}$
- COM = Permanent single point constraints for $\theta=180^{\circ}$
- CTM = Permanent single point constraints for $\theta=270^{\circ}$
- CBM = Permanent single point constraints for all other θ's

APPENDIX A

JIG FORTRAN LISTING

```
      PROGRAM JIG(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,PUNCH)
C *** JUNCTION INPUT GENERATOR PROGRAM (JIG)
      DIMENSION X(30,30),Z(30,30),NT(10),NG(30,30),DELTZ(10),CODE(30,30)      BUG
      DIMENSION NGF(30,30),KSKIP(30,30),KK(10),THETA(10),JB(10),JE(10)
     1,BETA(10),IMIN(30),IMAX(30),TITLE(13)
      COMMON X,Z,NG,CODE,NGF,KSKIP,NSECT,JB,JE,BETA,THETA,IMIN,IMAX,JMAX
     11,JMIN1
      COMMON MPC,IU(2),JU(2),IM(2),JM(2),IL(2),JL(2),ICON,LS(2)
      COMMON ICONST(2),JCONST(2)
      INTEGER CODE
      ICON = 1
      PRINT 99                                                                BUG
      WRITE(6,800)
      WRITE(6,800)
      WRITE(6,801)
      WRITE(6,802)
      WRITE(6,801)
      WRITE(6,800)
      WRITE(6,800)
      WRITE(6,803)
      READ(5,500)(TITLE(I),I=1,13)
      WRITE(6,501)(TITLE(I),I=1,13)
      READ (5,302) NST,NGS,NES,NPOP,MID,NGP,IDELT,NSECT
      WRITE(6,502) NST,NGS,NES,NPOP,MID,NGP,IDELT,NSECT
      I=1                                                                     BUG
    7 READ(5,302) NT(I),NT(I+1),NT(I+2),NT(I+3),NT(I+4),NT(I+5),NT(I+6)       BUG
      READ(5,304) DELTZ(I),DELTZ(I+1),DELTZ(I+2),DELTZ(I+3),DELTZ(I+4),       BUG
     1DELTZ(I+5),DELTZ(I+6)                                                   BUG
      I=I+7                                                                   BUG
      IF(I.LT.NST) GO TO 7                                                    BUG
      DO 10 J=1,NST
   10 WRITE(6,503) J,NT(J),J,DELTZ(J)
      IF(IDELT.EQ.0) GO TO 3
      READ(5,411) NDT,ICLOSE,DELGP
      WRITE(6,504) NDT,ICLOSE,DELGP
      IF=NDT+1
      READ(5,410) (KK(J),THETA(J),J=1,IF)
      DO 11 L=1,IF
   11 WRITE(6,505) L,KK(L),L,THETA(L)
      MAD = KK(NDT + 1) -1
      NS =NSECT + 1
      READ(5,304)(BETA(LM),LM=1,NS)
      DO 12 M=1,NS
   12 WRITE(6,506) M,BETA(M)
      READ(5,302)(JB(LN),JE(LN),LN=1,NSECT)
      DO 13 N=1,NSECT
   13 WRITE(6,507) N,JB(N),N,JE(N)
    3 I=1                                                                     BUG
      PRINT 99
      DO 700 L=1,NST                                                          BUG
      NN=NT(I)                                                                BUG
      DO 600 LL=1,NN                                                          BUG
      CALL TOOTH(JMIN,JMAX,MINI,MAXI,NPC,NTR,JMINJ,JMAXJ,DELTZ,LL,L,NPS,
     1IDELT,MAD)
      CALL PUNCHR(JMIN,JMAX,MINI,MAXI,NPO,NT,NTR,L,JMINJ,JMAXJ,NGS
     1,LL,NES,NPOP,MID,NGP,IDELT,NDT,ICLOSE,DELGP,KK,NPS)
  600 CONTINUE                                                                BUG
  700 I=I+1                                                                   BUG
   99 FORMAT(1H1)                                                             BUG
  302 FORMAT(8I5)
  304 FORMAT(7F10.4)                                                          BUG
  410 FORMAT(5(I5,F10.4))
  411 FORMAT(3I5)
  500 FORMAT(13A6)
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  501 FORMAT(15X,13A6,//)
  502 FORMAT(10X,6HNST = ,I5,/,10X,6HNGS = ,I5,/,10X,6HNES = ,I5,/,10X,7
     1HNPOP = ,I5,/,10X,6HMID = ,I5,/,10X,6HNGP = ,I5,/,10X,8HIDELT = ,I
     25,/,10X,8HNSECT = ,I5)
  503 FORMAT(10X,3HNT(,I2,4H) = ,I5,5X,6HDELTZ(,I2,4H) = ,F10.4)
  504 FORMAT(10X,6HNDT = ,I5,/,10X,9HICLOSE = ,I5,/,10X,8HDELGP = ,I5)
  505 FORMAT(10X,3HKK(,I2,4H) = ,I5,5X,6HTHETA(,I2,4H) = ,F10.4)
  506 FORMAT(10X,5HBETA(,I2,4H) = ,F10.4)
  507 FORMAT(10X,3HJB(,I2,4H) = ,I5,5X,3HJE(,I2,4H) = ,I5)
  800 FORMAT(35X,50H**************************************************)
  801 FORMAT(35X,2H**,46X,2H**)
  802 FORMAT(35X,2H**,3X,40HJUNCTION INPUT GENERATOR PROGRAM   (JIG),
     13X,2H**)
  803 FORMAT(/////)
      END                                                              BUG
      SUBROUTINE TOOTH(JMIN,JMAX,MINI,MAXI,NPO,NTR,JMINJ,JMAXJ,DELTZ,LL,
     1L,NPS,IDELT,MAO)
      DIMENSION X(30,30),Z(30,30),CODE(30,30),NPH(10),IMIN(30),IMAX(30)  TOOTH
      DIMENSION NJ7(30),N7(30),NG(30,30),DELTZ(10),NGF(30,30),KSKIP(30,  TOOTH
     130),JB(10),JE(10),BETA(10),THETA(10)
      COMMON X,Z,NG,CODE,NGF,KSKIP,NSECT,JB,JE,BETA,THETA,IMIN,IMAX,JMAX
     11,JMIN1
      COMMON MPC,IU(2),JU(2),MI(2),JM(2),IL(2),LJ(2),ICON,LS(2)
      COMMON ICONST(2),JCONST(2)
C *** THIS SUBROUTINE CALCULATES THE GRID POINT COORDINATES OF ANY        TOOTH
C *** SECTION.                                                           TOOTH
      INTEGER CODE                                                       TOOTH
      IF(LL.GT.1) GO TO 800                                              TOOTH
      READ (5,10) NEBP,JMIN,JMAX,MINI,MAXI,NHO,NPO,NTR,JMINJ,JMAXJ,NPS,
     1MPC
C*****  INITIALIZE                                                       TOOTH
      JRAN = JMAX - JMIN +1                                              TOOTH
      IRAN = MAXI - MINI +1                                              TOOTH
      IRNN = IRAN + 1                                                    TOOTH
      JRNN = JRAN + 1                                                    TOOTH
      DO 20 J = 1,JRNN                                                   TOOTH
      DO 15 I = 1,IRNN                                                   TOOTH
      X(I,J) = 0.                                                        TOOTH
      Z(I,J) = 0.                                                        TOOTH
      NG(I,J)=0                                                          TOOTH
      NGF(I,J)=0                                                         TOOTH
      KSKIP(I,J)=0                                                       TOOTH
   15 CODE(I,J) = 0                                                      TOOTH
      IMIN(J) = 1000                                                     TOOTH
   20 IMAX(J) = 0                                                        TOOTH
      DO 21 I=1,30                                                       TOOTH
      NJ7(I)=0                                                           TOOTH
      N7(I)=0                                                            TOOTH
   21 CONTINUE                                                           TOOTH
      IF(MPC.EQ.0) GO TO 200
      READ(5,49) NBC
      DO 201 M=1,NBC
  201 READ(5,49) IU(M),JU(M),MI(M),JM(M),IL(M),LJ(M),LS(M),ICONST(M),
     1JCONST(M)
C***** READ EXTERNAL BOUNDARY NODAL POINT DATA                          TOOTH
  200 IF(NPO.EQ.0) GO TO 4
      READ(5,26) JP,ZP,XP                                                TOOTH
      CODE(1,JP)=1                                                       TOOTH
      Z(1,JP)=ZP                                                         TOOTH
      X(1,JP)=XP                                                         TOOTH
    4 NCC = 0                                                            TOOTH
      NB = (NEBP+1) / 2                                                  TOOTH
      NBC = 2 * NB                                                       TOOTH
      DO 17 N = 1,NB                                                     TOOTH
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      READ(5,25) I1,J1,Z1,X1,IC1,I2,J2,Z2,X2,IC2
      CODE( I1,J1) = 1                                                  TOOTH
      CODE(I2,J2) = 1                                                   TOOTH
      Z(I1,J1) = Z1                                                     TOOTH
      X(I1,J1) = X1                                                     TOOTH
      Z(I2,J2) = Z2                                                     TOOTH
      X(I2,J2) = X2                                                     TOOTH
      IF(N.EQ.1) GO TO 5                                                TOOTH
      IF(N.EQ.NB) GO TO 6                                               TOOTH
  309 IF(IFC.EQ.1) GO TO 7
  311 READ(5,302) R0,A,B,C,D,E,F
    7 NSTEPS = MAX0(IABS(I1-IF),IABS(J1-JF))                            TOOTH
      ISTEP = (I1-IF) /NSTEPS                                           TOOTH
      JSTEP = (J1-JF) /NSTEPS                                           TOOTH
      DD = NSTEPS                                                       TOOTH
      DZ=(Z1-ZF)/DD                                                     TOOTH
      DX = (X1-XF)/DD                                                   TOOTH
      DO 8 NST = 1,NSTEPS                                               TOOTH
      I = IF + ISTEP *NST                                               TOOTH
      J = JF + JSTEP *NST                                               TOOTH
      IF(CODE(I,J).EQ.1) GO TO 8
      Z(I,J)=Z(I-ISTEP,J-JSTEP) + DZ                                    TOOTH
      IF(IFC.EQ.2) GO TO 312
      X(I,J) = X(I-ISTEP,J-JSTEP) + DX                                  TOOTH
      GO TO 313
  312 X(I,J) = R0 + A*Z(I,J) + B*Z(I,J)*Z(I,J) + C*Z(I,J)*Z(I,J)*Z(I,J)
     1 + D*COS(E*Z(I,J) + F)
  313 CODE(I,J) = 1
    8 CONTINUE                                                          TOOTH
      IFC = IC2
      IF(NCC.EQ.1) GO TO 17                                             TOOTH
      ZF=Z2                                                             TOOTH
      XF = X2                                                           TOOTH
      IF = I2                                                           TOOTH
      JF = J2                                                           TOOTH
      GO TO 12                                                          TOOTH
    5 XL = X1                                                           TOOTH
      ZL=Z1                                                             TOOTH
      XF = X2                                                           TOOTH
      ZF=Z2                                                             TOOTH
      LI = I1                                                           TOOTH
      JL = J1                                                           TOOTH
      IF = I2                                                           TOOTH
      JF = J2                                                           TOOTH
      IFC = IC2
      GO TO 12                                                          TOOTH
    6 IF(NBC.EQ.NFBP ) GO TO 9                                          TOOTH
      NSTEPS = MAX0(IABS(LI-I1),IABS(JL-J1) )                           TOOTH
      ISTEP = (LI-I1) /NSTEPS                                           TOOTH
      JSTEP  = (JL-J1) /NSTEPS                                          TOOTH
      DD = NSTEPS                                                       TOOTH
      DZ=(ZL-Z1)/DD                                                     TOOTH
      DX = (XL -X1) /DD                                                 TOOTH
      DO 14 NST = 1,NSTEPS                                              TOOTH
      I = I1 + ISTEP *NST                                               TOOTH
      J = J1 + JSTEP  *NST                                              TOOTH
      IF(CODE(I,J).EQ.1) GO TO 14
      Z(I,J)=Z(I-ISTEP,J-JSTEP) + DZ                                    TOOTH
      IF(IC1.EQ.2) GO TO 315
      X(I,J) = X(I-ISTEP,J-JSTEP) +DX                                   TOOTH
      GO TO 316
  315 X(I,J) = R0 + A*Z(I,J) + B*Z(I,J)*Z(I,J) + C*Z(I,J)*Z(I,J)*Z(I,J)
     1 + D*COS(E*Z(I,J) + F)
  316 CODE(I,J) = 1                                                     TOOTH
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   14 CONTINUE                                                          TOOTH
      NCC = 1                                                           TOOTH
      GO TO 309
    9 NSTEPS = MAX0(IABS(LI-I2),IABS(JL-J2) )                           TOOTH
      ISTEP = (LI-I2) /NSTEPS                                           TOOTH
      JSTEP = (JL-J2) /NSTEPS                                           TOOTH
      DD = NSTEPS                                                       TOOTH
      IF(IC2.EQ.2) READ(5,302) R0,A,B,C,D,F,F
      DZ=(ZL-Z2)/DD                                                     TOOTH
      DX =(XL-X2) /DD                                                   TOOTH
      DO 11 NST = 1,NSTEPS                                              TOOTH
      I = I2 + ISTEP *NST                                               TOOTH
      J = J2 + JSTEP *NST                                               TOOTH
      IF(CODE(I,J).EQ.1) GO TO 11
      Z(I,J)=Z(I-ISTEP,J-JSTEP) + DZ                                    TOOTH
      IF(IC2.EQ.2) GO TO 305
      X(I,J) = X(I-ISTEP,J-JSTEP) + DX                                  TOOTH
      GO TO 306
  305 X(I,J) = R0 + A*Z(I,J) + B*Z(I,J)*Z(I,J) + C*Z(I,J)*Z(I,J)*Z(I,J)
     1 + D*COS(F*Z(I,J) + F)
  306 CODE(I,J) = 1                                                     TOOTH
   11 CONTINUE                                                          TOOTH
      GO TO 309
   12 IF(IC1.EQ.2) READ(5,302) R0,A,B,C,D,E,F
      NSTEPS = MAX0(IABS(I2-I1),IABS(J2-J1) )
      ISTEP = (I2-I1) /NSTEPS                                           TOOTH
      JSTEP = (J2-J1) /NSTEPS                                           TOOTH
      DD = NSTEPS                                                       TOOTH
      DZ=(Z2-Z1)/DD                                                     TOOTH
      DX = (X2-X1) /DD                                                  TOOTH
      DO 18 NST = 1,NSTEPS                                              TOOTH
      I = I1 + ISTEP *NST                                               TOOTH
      J = J1 + JSTEP  *NST                                              TOOTH
      IF(CODE(I,J).EQ.1) GO TO 18
      Z(I,J)=Z(I-ISTEP,J-JSTEP) + DZ                                    TOOTH
      IF(IC1.EQ.2) GO TO 303
      X(I,J) = X(I-ISTEP,J-JSTEP) + DX                                  TOOTH
      GO TO 304
  303 X(I,J) = R0 + A*Z(I,J) + B*Z(I,J)*Z(I,J) + C*Z(I,J)*Z(I,J)*Z(I,J)
     1 + D*COS(E*Z(I,J) + F)
  304 CODE(I,J) = 1                                                     TOOTH
   18 CONTINUE                                                          TOOTH
   17 CONTINUE                                                          TOOTH
C****** READ INTERNAL BOUNDARY NODAL POINT DATA                        TOOTH
      IF(NHO.EQ.0) GO TO 53                                             TOOTH
      READ (5,49) (NPH(N),N=1,NHO)                                      TOOTH
      DO 52 N = 1,NHO                                                   TOOTH
      NCC = 0                                                           TOOTH
      NB = (NPH(N) +1) /2                                               TOOTH
      NBC = 2*NB                                                        TOOTH
      DO 50 N9 = 1,NB                                                   TOOTH
      NG1=0                                                             TOOTH
      READ(5,27) I1,J1,Z1,X1,NG1,IPO,I2,J2,Z2,X2                        TOOTH
      IF(NPH(N).EQ.2) GO TO 22                                          TOOTH
      IF(NG1.NE.0) GO TO 101                                            TOOTH
      GO TO 88                                                          TOOTH
  101 NG(I1,J1)=NG1                                                     TOOTH
      NGF(I1,J1)=NG1                                                    TOOTH
      IF(IPO.EQ.0) KSKIP(I1,J1) = -1
      GO TO 88                                                          TOOTH
   22 IF(NG1.LT.0) GO TO 102                                            TOOTH
      IF(NG1.EQ.0) GO TO 88                                             TOOTH
      IF(I2.EQ.I1) GO TO 72                                             TOOTH
      DO 71 M=I1,I2                                                     TOOTH
```

```
      NG(M,J1)=NG1                                                    TOOTH
      NGF(M,J1) =I2 + NG1 -I1                                         TOOTH
      KSKIP(M,J1) = I2-I1                                             TOOTH
      IF(IPO.EQ.0) KSKIP(M,J1)=-1*KSKIP(M,J1)                         TOOTH
      IF(IDELT.EQ.1) NG1 = NG1 + MAD
   71 NG1=NG1+1                                                       TOOTH
      GO TO 88                                                        TOOTH
   72 DO 73 M=J1,J2                                                   TOOTH
      NG(I1,M)=NG1                                                    TOOTH
      NGF(I1,M)=J2 + NG1 - J1                                         TOOTH
      KSKIP(I1,M)=J2-J1                                               TOOTH
      IF(IPO.EQ.0) KSKIP(I1,M)=-1*KSKIP(I1,M)                         TOOTH
      IF(IDELT.EQ.1) NG1 = NG1 + MAD
   73 NG1=NG1+1                                                       TOOTH
      GO TO 88                                                        TOOTH
  102 IF(I2.EQ.I1) GO TO 104                                          TOOTH
      DO 105 M=I1,I2                                                  TOOTH
      NG(M,J1) = (-1)*NG1                                             TOOTH
      NGF(M,J1)=I2-I1+NG1                                             TOOTH
      KSKIP(M,J1) = I2-I1                                             TOOTH
      IF(IPO.EQ.0) KSKIP(M,J1)=-1*KSKIP(M,J1)                         TOOTH
      IF(IDELT.EQ.1) NG1 = NG1 + MAD
  105 NG1=NG1+1                                                       TOOTH
      GO TO 88                                                        TOOTH
  104 DO 106 M=J1,J2                                                  TOOTH
      NG(I1,M) = (-1)*NG1                                             TOOTH
      NGF(I1,M)=J2-J1+NG1                                             TOOTH
      KSKIP(I1,M)=J2-J1                                               TOOTH
      IF(IPO.EQ.0) KSKIP(I1,M)=-1*KSKIP(I1,M)                         TOOTH
      IF(IDELT.EQ.1) NG1 = NG1 + MAD
  106 NG1=NG1+1                                                       TOOTH
   88 IF(X1.LT.0.0) GO TO 50
      IF(NB.EQ.1) GO TO 30                                            TOOTH
      GO TO 35                                                        TOOTH
   30 IF(NBC.EQ.NPH(N)) GO TO 32                                      TOOTH
      CODE(I1,J1) = 2                                                 TOOTH
      Z(I1,J1)=Z1                                                     TOOTH
      X(I1,J1) = X1                                                   TOOTH
      GO TO 50                                                        TOOTH
   32 IF(CODE(I1,J1).EQ.1) GO TO 80                                   TOOTH
      CODE(I1,J1) = 2                                                 TOOTH
   80 IF(CODE(I2,J2).EQ.1) GO TO 81                                   TOOTH
      CODE(I2,J2) = 2                                                 TOOTH
   81 CONTINUE                                                        TOOTH
      Z(I1,J1) = Z1                                                   TOOTH
      X(I1,J1) = X1                                                   TOOTH
      Z(I2,J2) = Z2                                                   TOOTH
      X(I2,J2) = X2                                                   TOOTH
      NSTEPS = MAX0(IABS(I2-I1),IABS(J2-J1) )                         TOOTH
      ISTEP = (I2-I1) /NSTEPS                                         TOOTH
      JSTEP = (J2-J1) /NSTEPS                                         TOOTH
      DD = NSTEPS                                                     TOOTH
      DZ=(Z2-Z1)/DD                                                   TOOTH
      DX = (X2-X1) /DD                                                TOOTH
      DO 33 NST = 1,NSTEPS                                            TOOTH
      I = I1 + ISTEP *NST                                             TOOTH
      J = J1 + JSTEP  *NST                                            TOOTH
      Z(I,J)=Z(I-ISTEP,J-JSTEP) + DZ                                  TOOTH
      X(I,J) = X(I-ISTEP,J-JSTEP) + DX                                TOOTH
      IF(CODE(I,J).EQ.1) GO TO 33                                     TOOTH
      CODE(I,J) = 2                                                   TOOTH
   33 CONTINUE                                                        TOOTH
      GO TO 50                                                        TOOTH
   35 IF(N9.EQ.1) GO TO 36                                            TOOTH
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      IF(N9.EQ.NB) GO TO 37                                              TOOTH
   38 NSTEPS = MAX0(IABS(I1-IF),IABS(J1-JF) )                            TOOTH
      ISTEP = (I1-IF) /NSTEPS                                            TOOTH
      JSTEP = (J1-JF) /NSTEPS                                            TOOTH
      DD = NSTEPS                                                        TOOTH
      DZ=(Z1-ZF)/DD                                                      TOOTH
      DX = (X1-XF) /DD                                                   TOOTH
      DO 39 NST = 1,NSTEPS                                               TOOTH
      I = IF +ISTEP  *NST                                                TOOTH
      J = JF + JSTEP *NST                                                TOOTH
      Z(I,J)=Z(I-ISTEP,J-JSTEP) + DZ                                     TOOTH
      X(I,J) = X(I-ISTEP,J-JSTEP) +DX                                    TOOTH
      IF(CODE(I,J).EQ.1) GO TO 39                                        TOOTH
      CODE(I,J) = 2                                                      TOOTH
   39 CONTINUE                                                           TOOTH
      IF(NCC.EQ.1) GO TO 50                                              TOOTH
      ZF=Z2                                                              TOOTH
      XF = X2                                                            TOOTH
      IF = I2                                                            TOOTH
      JF = J2                                                            TOOTH
      GO TO 32                                                           TOOTH
   36 XL = X1                                                            TOOTH
      ZL=Z1                                                              TOOTH
      XF = X2                                                            TOOTH
      ZF=Z2                                                              TOOTH
      LI = I1                                                            TOOTH
      JL = J1                                                            TOOTH
      IF = I2                                                            TOOTH
      JF = J2                                                            TOOTH
      GO TO 32                                                           TOOTH
   37 IF(NBC.EQ.NPH(N) ) GO TO 40                                        TOOTH
      NSTEPS = MAX0(IABS(LI-I1),IABS(JL-J1) )                            TOOTH
      ISTEP = (LI-I1) /NSTEPS                                            TOOTH
      JSTEP = (JL-J1) /NSTEPS                                            TOOTH
      DD = NSTEPS                                                        TOOTH
      DZ=(ZL-Z1)/DD                                                      TOOTH
      DX = (XL-X1) /DD                                                   TOOTH
      DO 42 NST = 1,NSTEPS                                               TOOTH
      I = I1 + ISTEP *NST                                                TOOTH
      J = J1 + JSTEP  *NST                                               TOOTH
      Z(I,J)=Z(I-ISTEP,J-JSTEP) + DZ                                     TOOTH
      X(I,J) = X(I-ISTEP,J-JSTEP) + DX                                   TOOTH
      IF(CODE(I,J).EQ.1) GO TO 42                                        TOOTH
      CODE(I,J) = 2                                                      TOOTH
   42 CONTINUE                                                           TOOTH
      NCC = 1                                                            TOOTH
      GO TO 38                                                           TOOTH
   40 NSTEPS = MAX0(IABS(LI-I2),IABS(JL-J2) )                            TOOTH
      ISTEP = (LI-I2) /NSTEPS                                            TOOTH
      JSTEP = (JL-J2) /NSTEPS                                            TOOTH
      DD = NSTEPS                                                        TOOTH
      DZ=(ZL-Z2)/DD                                                      TOOTH
      DX = (XL-X2) /DD                                                   TOOTH
      DO 44 NST = 1,NSTEPS                                               TOOTH
      I = I2 + ISTEP *NST                                                TOOTH
      J = J2 + JSTEP *NST                                                TOOTH
      Z(I,J)=Z(I-ISTEP,J-JSTEP) + DZ                                     TOOTH
      X(I,J) = X(I-ISTEP,J-JSTEP) + DX                                   TOOTH
      IF(CODE(I,J).EQ.1) GO TO 44                                        TOOTH
      CODE(I,J) = 2                                                      TOOTH
   44 CONTINUE                                                           TOOTH
      GO TO 38                                                           TOOTH
   50 CONTINUE                                                           TOOTH
   52 CONTINUE                                                           TOOTH
```

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C*****  CALCULATE COORDINATES OF INTERIOR POINTS                          TOOTH
   53 IF(JRAN.LE.2) GO TO 800                                            TOOTH
      N9 =0                                                              TOOTH
      DO 69 J = 1,JRAN                                                   TOOTH
      NMIC = 0                                                           TOOTH
      NMAC = 0                                                           TOOTH
      N9 = N9+1                                                          TOOTH
      DO 54 I = 1,IRAN                                                   TOOTH
      IF(CODE(I,J).EQ.1) GO TO 57                                        TOOTH
      GO TO 55                                                           TOOTH
   57 IF(NMIC.EQ.1) GO TO 58                                             TOOTH
      IMIN(J) = I                                                        TOOTH
      NMIC = 1                                                           TOOTH
      IF(CODE(I,J+1).EQ.1) GO TO 55                                      TOOTH
      IF(CODE(I+1,J+1).EQ.1) GO TO 59                                    TOOTH
      IF(CODE(I-1,J+1).EQ.1) GO TO 60                                    TOOTH
      GO TO 55                                                           TOOTH
   59 IF(CODE(I-1,J+1).EQ.1) GO TO 65                                    TOOTH
      NJ7(N9) = J                                                        TOOTH
      N7(N9) = 7                                                         TOOTH
      GO TO 55                                                           TOOTH
   60 NJ7(N9) = J                                                        TOOTH
      N7(N9) = 5                                                         TOOTH
      GO TO 55                                                           TOOTH
   58 IF(CODE(I+1,J).EQ.0) GO TO 61                                      TOOTH
      GO TO 55                                                           TOOTH
   61 IMAX(J) = I                                                        TOOTH
      NMAC = 1                                                           TOOTH
      IF(CODE(I,J+1).EQ.1) GO TO 55                                      TOOTH
      IF(CODE(I-1,J+1).EQ.1) GO TO 62                                    TOOTH
      IF(CODE(I+1,J+1).EQ.1) GO TO 63                                    TOOTH
      GO TO 55                                                           TOOTH
   62 N7(N9)= N7(N9)*10+8                                                TOOTH
      NJ7(N9) = J                                                        TOOTH
      GO TO 55                                                           TOOTH
   63 N7(N9) = N7(N9) *10 + 6                                            TOOTH
      NJ7(N9) = J                                                        TOOTH
   55 IF(I.EQ.IRAN) GO TO 64                                             TOOTH
      GO TO 54                                                           TOOTH
   64 IF(NMAC.EQ.0) GO TO 65                                             TOOTH
      GO TO 54                                                           TOOTH
   65 IF(CODE(I,J).EQ.2) GO TO 57
      IMAX(J) = IMIN(J)
      NMAC = 1                                                           TOOTH
      IF(J.EQ.JRAN ) GO TO 54                                            TOOTH
      NJ7(N9) = J                                                        TOOTH
      N7(N9) = 5566                                                      TOOTH
   54 CONTINUE                                                           TOOTH
   69 CONTINUE                                                           TOOTH
      J2 = JRAN - 1                                                      TOOTH
      J77 = JMIN + 1                                                     TOOTH
      DO 75 N = 1,500                                                    TOOTH
      RESID = 0.                                                         TOOTH
      DO 70 J = J77,J2                                                   TOOTH
      IRAN = IMAX(J) -1                                                  TOOTH
      IN = IMIN(J)                                                       TOOTH
      IM = IMIN(J)                                                       TOOTH
      IN7 = IMIN(J) +1                                                   TOOTH
      DO 70 I = IN7,IRAN                                                 TOOTH
      IN = IN + 1                                                        TOOTH
      IM = IM + 1                                                        TOOTH
      IF(CODE(I,J).EQ.1) GO TO 70                                        TOOTH
      IF(CODE(I,J).EQ.2) GO TO 70                                        TOOTH
      DZ=(Z(IN,J+1)+Z(IM,J-1)+Z(I+1,J)+Z(I-1,J))/4. -Z(I,J)              TOOTH
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      DX = (X(IN,J+1)+X(IM,J-1)+X(I+1,J)+X(I-1,J))/4.-X(I,J)                TOOTH
      Z(I,J) = Z(I,J) + 1.8*DZ                                              TOOTH
      X(I,J) = X(I,J) + 1.8*DX                                              TOOTH
      RESID = RESID + ABS(DX) + ABS(DZ)                                     TOOTH
   70 CONTINUE                                                              TOOTH
      IF(N.EQ.1) RES1 = RESID                                               TOOTH
      IF(RES1.EQ.0.0) GO TO 800
      IF(RESID/RES1.LT.1.E-5) GO TO 800                                     TOOTH
   75 CONTINUE                                                              TOOTH
  800 CONTINUE                                                              TOOTH
      IF(JRAN.LE.2) GO TO 110
      GO TO 115
  110 IMIN(1) = IMIN(2) = MINI
      IMAX(1) = IMAX(2) = MAXI
  115 IF(LL.EQ.1) GO TO 92                                                  TOOTH
      I=MINI                                                                TOOTH
   90 CONTINUE                                                              TOOTH
      J=JMIN                                                                TOOTH
   91 CONTINUE                                                              TOOTH
      Z(I,J)=Z(I,J)+DELTZ(L)                                                TOOTH
      J=J+1                                                                 TOOTH
      IF(J.LE.JMAX) GOTO 91                                                 TOOTH
      I=I+1                                                                 TOOTH
      IF(I.LE.MAXI) GOTO 90                                                 TOOTH
      IF(NPO.EQ.0) GO TO 82                                                 TOOTH
      Z(1,JP)=Z(1,JP) + DELTZ(L)                                            TOOTH
   92 CONTINUE                                                              TOOTH
   82 WRITE(6,99)                                                           TOOTH
   99 FORMAT(///,9X,1HI,4X,1HJ,5X,6HZ(I,J),6X,6HX(I,J),2X,9HCODE(I,J),/)
      DO 85 J=JMIN,JMAX
      IB = IMIN(J)
      IE = IMAX(J)
      DO 86 I=IB,IE
      WRITE(6,100) I,J,Z(I,J),X(I,J),CODE(I,J)                              TOOTH
  100 FORMAT(5X,2I5,2F12.5,I5)
   86 CONTINUE                                                              TOOTH
   85 CONTINUE                                                              TOOTH
      IF(NPO.EQ.0) GO TO 45                                                 TOOTH
      I=1                                                                   TOOTH
      WRITE(6,100) I,JP,Z(I,JP),X(I,JP),CODE(I,JP)                          TOOTH
   45 CONTINUE                                                              TOOTH
   10 FORMAT(12I5)
   25 FORMAT(2I5,2F10.5,3I5,2F10.5,I5)
   26 FORMAT(I5,2F10.5)                                                     TOOTH
   27 FORMAT(2I5,2F10.5,4I5,2F10.5)                                         TOOTH
   49 FORMAT(10I5)                                                          TOOTH
  302 FORMAT(7F10.4)
      RETURN                                                                TOOTH
      END                                                                   TOOTH
      SUBROUTINE PUNCHR(JMIN,JMAX,MINI,MAXI,NPO,NT,NTR,L,JMINJ,JMAX
     1J,NGS,LL,NES,NPOP,MID,NGP,IDELT,NDT,ICLOSE,DELGP,KK,NPS)
      DIMENSION X(30,30),Z(30,30),JT(10),NTNT(10),NT(10),NG(30,30)          PUNCHR
      DIMENSION NCG(1,30),CODE(30,30),NGF(30,30),KSKIP(30,30)               PUNCHR
      DIMENSION KK(10),THETA(10),JB(10),JE(10),BETA(10),IMIN(30),IMAX(30
     1)
      COMMON X,Z,NG,CODE,NGF,KSKIP,NSECT,JB,JE,BETA,THETA,IMIN,IMAX,JMAX
     11,JMIN1
      COMMON MPC,IU(2),JU(2),IM(2),JM(2),IL(2),JL(2),ICON,LS(2)
      COMMON ICONST(2),JCONST(2)
      INTEGER DELGP,G1,G2,G3
C     *** THIS SUBROUTINE PUNCHES GRID CARDS AND ELEMENT CONNECTION CARDS    PUNCHR
C     *** (CTRIA2 AND CTRIARG).                                             PUNCHR
      NCALL = 0
      NCP=0                                                                 PUNCHR
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      NCP1=1
      IFIX1 = 0
      IFIX2 = 0
      LSTEP=0                                                    PUNCHR
      Y=0.0                                                      PUNCHR
      NCD=0                                                      PUNCHR
      TH=0.0                                                     PUNCHR
      IPID=1                                                     PUNCHR
      IF(IDELT.EQ.1) MAD = KK(NOT+1) - 1
    3 IF(L.GT.1.OR.LL.GT.1) GO TO 40                             PUNCHR
      INTN=0                                                     PUNCHR
      IEID=NES                                                   PUNCHR
      GO TO 46                                                   PUNCHR
   40 LSTEP=1                                                    PUNCHR
      IEID=IELAST                                                PUNCHR
      NGS=NGLAST                                                 PUNCHR
      IF(LL.EQ.1) GO TO 46                                       PUNCHR
      GO TO 44                                                   PUNCHR
   46 IF(NTR.EQ.0) GO TO 10                                      PUNCHR
      READ(5,400) INTN                                           PUNCHR
      DO 5 I=1,NTR                                               PUNCHR
      READ(5,402) JT(I),NTNT(I)                                  PUNCHR
    5 CONTINUE                                                   PUNCHR
   10 CONTINUE                                                   PUNCHR
      IF(NTR.EQ.0) INTN=0                                        PUNCHR
   44 K=1                                                        PUNCHR
      DO 170 J=JMIN,JMAX                                         PUNCHR
      IF(J.EQ.JMIN) ISKIP=2**INTN                                PUNCHR
      IF(NTR.EQ.0) GO TO 12                                      PUNCHR
      IF(K.GT.NTR) GO TO 12                                      PUNCHR
      IF(J.EQ.JT(K)) GO TO 11                                    PUNCHR
      GO TO 12                                                   PUNCHR
   11 ISKIP =2**NTNT(K)                                          PUNCHR
      K=K + 1                                                    PUNCHR
   12 DO 150 I=MINI,MAXI,ISKIP                                   PUNCHR
      ICALL = 0
      IF(IMIN(J).GT.I) GO TO 150
      IF(IMAX(J).LT.I) GO TO 150
      IF(I.EQ.MINI.AND.LSTEP.EQ.1) GO TO 62                      PUNCHR
      GO TO 63                                                   PUNCHR
   62 IF(JMINJ.NE.JMINJ1) GO TO 4                                PUNCHR
      IF(J.GE.JMINJ.AND.J.LE.JMAXJ1) NG(I,J) = NCG(1,J)
      GO TO 63                                                   PUNCHR
    4 IF(J.GE.JMINJ.AND.J.LE.JMAXJ) NG(I,J)=NCG(1,JMINJ1)        PUNCHR
      JMINJ1=JMINJ1 + 1
   63 IF(I.EQ.MAXI) GO TO 35                                     PUNCHR
      GO TO 36                                                   PUNCHR
   35 IF(J.LE.JMAXJ.AND.J.GE.JMINJ) GO TO 37                     PUNCHR
      GO TO 36                                                   PUNCHR
   37 IF(NGF(I,J).NE.0) GO TO 55
      NG(I,J) = NGS
      NCG(1,J)=NG(I,J)                                           PUNCHR
      NGS = NGS + 1
      IF(IDELT.EQ.1) NGS = NGS + MAD
      IF(ICLOSE.EQ.0.AND.IDELT.EQ.1) NGS = NGS - 1
      NGLAST = NGS
      GO TO 20                                                   PUNCHR
   36 IF(LSTEP.EQ.1.AND.I.GT.MINI) GO TO 15                      PUNCHR
      IF(NG(I,J).EQ.0) GO TO 15                                  PUNCHR
      IF(NGF(I,J).NE.0) GO TO 55                                 PUNCHR
      IF(I.GT.MINI) GO TO 20                                     PUNCHR
      IF(J.GT.JMAXJ1.OR.J.LT.JMINJ) GO TO 15
      GO TO 20                                                   PUNCHR
   15 CONTINUE                                                   PUNCHR
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      IF(NGF(I,J).NE.0) GO TO 55                                        PUNCHR
      NG(I,J)=NGS                                                       PUNCHR
      NGS=NGS+1                                                         PUNCHR
      IF(IDELT.EQ.1) NGS = NGS+ MAD
      IF(ICLOSE.EQ.0.AND.IDELT.EQ.1) NGS = NGS - 1
      NGLAST=NGS                                                        PUNCHR
      GO TO 20                                                          PUNCHR
   55 IF(KSKIP(I,J).LT.0.AND.LL.EQ.1) GO TO 42                          PUNCHR
      IF(LL.EQ.1) GO TO 20                                              PUNCHR
      NG(I,J) = IABS(NGF(I,J)+1)                                        PUNCHR
      IF(IDELT.EQ.1.AND.NGF(I,J).LT.0) NG(I,J) = NG(I,J) - 1 - MAD
      IF(IDELT.EQ.1.AND.NGF(I,J).GT.0) NG(I,J) = NG(I,J) + 1 + MAD
      NGF(I,J)= IABS(KSKIP(I,J)) + NGF(I,J) + 1                         PUNCHR
      IF(IDELT.EQ.1) NGF(I,J) = NGF(I,J) + MAD + 1
      IF(KSKIP(I,J).LT.0) GO TO 43
   20 IF(I.EQ.MINI.AND.LSTEP.EQ.1) GO TO 50                             PUNCHR
      GO TO 51                                                          PUNCHR
   50 IF(J.LE.JMAXJ1.AND.J.GE.JMINJ) GO TO 43
   51 IF(J.EQ.1) GO TO 411
      IF(I.LT.IMIN(J-1).OR.I.GT.IMAX(J-1)) GO TO 411
      IF(ABS(X(I,J-1)).EQ.0.0.AND.ABS(X(I,J)).NE.0.0) Z(I,J) = Z(I,J-1)
  411 IF(I.EQ.1) GO TO 410
      IF(I-ISKIP.LT.IMIN(J)) GO TO 410
      IF(ABS(X(I-ISKIP,J)).EQ.0.0.AND.ABS(X(I,J)).NE.0.0) Z(I,J) = Z(I-I
     1SKIP,J)
  410 IF(NGP.EQ.1) GO TO 43
      IF(IDELT.EQ.1) GO TO 101
      IF(NPS.GT.0) GO TO 70
      PUNCH 910,NG(I,J),NCP,X(I,J),Y,Z(I,J),NCD
      WRITE(6,911) NG(I,J),NCP,X(I,J),Y,Z(I,J),NCD
      GO TO 43
   70 PUNCH 900,NG(I,J),NCP,X(I,J),Y,Z(I,J),NCD,NPS
      WRITE(6,901) NG(I,J),NCP,X(I,J),Y,Z(I,J),NCD,NPS
      GO TO 43
  101 II=1
      JJ = 1
      TH1 = THETA(II)
  102 IF(TH1.GE.BETA(JJ).AND.TH1.LE.BETA(JJ+1)) GO TO 600
      JJ = JJ+1
  600 IF(TH1.EQ.BETA(NSECT+1)) GO TO 605
      IF(TH1.EQ.BETA(JJ+1)) GO TO 602
      IF(TH1.EQ.BETA(JJ)) GO TO 602
  605 IF(J.LT.JB(JJ).OR.J.GT.JE(JJ)) GO TO 601
      IF(J.EQ.JB(JJ).AND.J.EQ.JMAX) GO TO 601
  602 IF(MPC.EQ.1) GO TO 608
      IF(NPS.GT.0) GO TO 73
      GO TO 609
  608 IF(LS(1).EQ.LS(2)) GO TO 700
      IF(LS(1).EQ.LL) GO TO 610
      IF(LS(2).EQ.LL) GO TO 611
      GO TO 609
  700 IF(I.EQ.ICONST(1).OR.J.EQ.JCONST(1)) ML = 1
      IF(I.EQ.ICONST(2).OR.J.EQ.JCONST(2)) ML = 2
      GO TO 612
  610 ML=1
      GO TO 612
  611 ML=2
  612 IF(I.EQ.IU(ML).AND.J.EQ.JU(ML)) GO TO 650
      IF(I.EQ.IM(ML).AND.J.EQ.JM(ML)) GO TO 650
      IF(I.EQ.IL(ML).AND.J.EQ.JL(ML)) GO TO 650
      IF(ML.EQ.2) GO TO 701
      IF(IFIX1.EQ.3) GO TO 350
      GO TO 351
  701 IF(IFIX2.EQ.3) GO TO 704
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      GO TO 351
  350 IFIX1 = 4
      CALL MPCP(ML,NCALL,I,J,NDT,KK,IFIX1,MAXI,JMAX)
      GO TO 660
  704 IFIX2 = 4
      CALL MPCP(ML,NCALL,I,J,NDT,KK,IFIX2,MAXI,JMAX)
      GO TO 660
  351 IF(NPS.GT.0) GO TO 73
      GO TO 609
  650 IF(ML.EQ.2) GO TO 702
      IFIX1 = IFIX1 + 1
      CALL MPCP(ML,NCALL,I,J,NDT,KK,IFIX1,MAXI,JMAX)
      GO TO 660
  702 IFIX2 = IFIX2 + 1
      CALL MPCP(ML,NCALL,I,J,NDT,KK,IFIX2,MAXI,JMAX)
  660 ICALL= 1
      IF(ML.EQ.2) GO TO 708
      IF(IFIX1.EQ.4) GO TO 351
      GO TO 601
  708 IF(IFIX2.EQ.4) GO TO 351
      GO TO 601
  609 PUNCH 910,NG(I,J),NCP1,X(I,J),TH1,Z(I,J),NCP1
      WRITE(6,911) NG(I,J),NCP1,X(I,J),TH1,Z(I,J),NCP1
      GO TO 601
   73 PUNCH 900,NG(I,J),NCP1,X(I,J),TH1,Z(I,J),NCP1,NPS
      WRITE(6,901) NG(I,J),NCP1,X(I,J),TH1,Z(I,J),NCP1,NPS
  601 IF(TH1.EQ.THETA(II+1)) II=II+1
      IF(ABS(TH1-THETA(NDT+1)).LT.0.001) GO TO 42
      DTHETA = (THETA(II+1)-THETA(II))/(KK(II+1)-KK(II))
      IF(ML.EQ.2) GO TO 706
      IF(ICALL.EQ.1.AND.IFIX1.NE.4) GO TO 43
      GO TO 707
  706 IF(ICALL.EQ.1.AND.IFIX2.NE.4) GO TO 43
  707 NG(I,J)=NG(I,J)+ 1
      TH1 = TH1 + DTHETA
      IF(TH1.EQ.360.0) GO TO 42
      GO TO 102
   42 IF(KSKIP(I,J).LT.0) GO TO 43
      IF(IDELT.EQ.1) NG(I,J) = NG(I,J) - (KK(NDT+1)- 1)
   43 IF(J.EQ. JMIN) GO TO 150
      IF(I.LE.IMIN(J)) GO TO 150
      IF(I.GT.IMAX(J)) GO TO 150
      IF(I.EQ.MINI) GO TO 150                                          PUNCHR
      IF(K.EQ.1) GO TO 6                                               PUNCHR
      IF(NTR.EQ.0) GO TO 6                                             PUNCHR
      IF(K-1.GT.NTR) GO TO 6                                           PUNCHR
      IF(J.EQ.JT(K-1)) GO TO 30                                        PUNCHR
    6 CONTINUE                                                         PUNCHR
      IF(IDELT.EQ.1) GO TO 500
      IF(ABS(X(I-ISKIP,J-1)).EQ.0.0) GO TO 300
      IF(NPOP.EQ.1) GO TO 80                                           PUNCHR
      PUNCH 902,IEID,IPID,NG(I,J),NG(I-ISKIP,J),NG(I-ISKIP,J-1),TH     PUNCHR
      WRITE(6,903) IEID,IPID,NG(I,J),NG(I-ISKIP,J),NG(I-ISKIP,J-1),TH  PUNCHR
      IF(NPOP.EQ.0) GO TO 90                                           PUNCHR
   80 PUNCH 904,IEID,NG(I,J),NG(I-ISKIP,J),NG(I-ISKIP,J-1),TH,MID      PUNCHR
      WRITE(6,905) IEID,NG(I,J),NG(I-ISKIP,J),NG(I-ISKIP,J-1),TH,MID   PUNCHR
      GO TO 90
  500 G3 = NG(I-ISKIP,J-1)
      G2 = NG(I-ISKIP,J)
      G1 = NG(I,J)
      IF(G3.EQ.0) GO TO 150
      IF(NG(I,J-1).EQ.0) GO TO 150
      CALL WEDGE(G1,G2,G3,DELGP,KK,MID,IEID,ICLOSE,NDT,NPOP,J)
   90 IEID = IEID + 1                                                  PUNCHR
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```
      IF(IDELT.EQ.1) GO TO 501
      IF(NPOP.EQ.1) GO TO 81                                              PUNCHR
      PUNCH 902,IEID,IPID,NG(I-ISKIP,J-1),NG(I,J-1),NG(I,J),TH            PUNCHR
      WRITE(6,903) IEID,IPID,NG(I-ISKIP,J-1),NG(I,J-1),NG(I,J),TH         PUNCHR
      IF(NPOP.EQ.0) GO TO 91                                              PUNCHR
   81 PUNCH 904,IEID,NG(I-ISKIP,J-1),NG(I,J-1),NG(I,J),TH,MID             PUNCHR
      WRITE(6,905) IEID,NG(I-ISKIP,J-1),NG(I,J-1),NG(I,J),TH,MID          PUNCHR
      GO TO 91
  501 G3 = NG(I,J)
      G2 = NG(I,J-1)
      G1 = NG(I-ISKIP,J-1)
      CALL WEDGE(G1,G2,G3,DELGP,KK,MID,IEID,ICLOSE,NDT,NPOP,J)
   91 IEID = IEID + 1                                                     PUNCHR
      GO TO 150
  300 IF(ABS(X(I,J-1)).EQ.0.0) GO TO 310
      IF(NPOP.EQ.1) GO TO 301
      PUNCH 906,IEID,IPID,NG(I-ISKIP,J-1),NG(I,J-1),NG(I,J),NG(I-ISKIP,J
     1),TH
      WRITE(6,907) IEID,IPID,NG(I-ISKIP,J-1),NG(I,J-1),NG(I,J),NG(I-ISKI
     1P,J),TH
      IF(NPOP.EQ.0) GO TO 302
  301 PUNCH 908,IEID,NG(I-ISKIP,J-1),NG(I,J-1),NG(I,J),NG(I-ISKIP,J),TH,
     1MID
      WRITE(6,909) IEID,NG(I-ISKIP,J-1),NG(I,J-1),NG(I,J),NG(I-ISKIP,J),
     1TH,MID
  302 IEID =IEID + 1
      GO TO 150
  310 IF(NPOP.EQ.1) GO TO 311
      PUNCH 906,IEID,IPID,NG(I,J-1),NG(I,J),NG(I-ISKIP,J),NG(I-ISKIP,J-1
     1),TH
      WRITE(6,907) IEID,IPID,NG(I,J-1),NG(I,J),NG(I-ISKIP,J),NG(I-ISKIP,
     1J-1),TH
      IF(NPOP.EQ.0) GO TO 312
  311 PUNCH 908,IEID,NG(I,J-1),NG(I,J),NG(I-ISKIP,J),NG(I-ISKIP,J-1),TH,
     1MID
      WRITE(6,909) IEID,NG(I,J-1),NG(I,J),NG(I-ISKIP,J),NG(I-ISKIP,J-1),
     1TH,MID
  312 IEID = IEID + 1
  320 CONTINUE
  330 CONTINUE
      GO TO 150                                                           PUNCHR
   30 IF(K-1.EQ.1) GO TO 21                                               PUNCHR
      IF(NTNT(K-1).GT.NTNT(K-2)) GO TO 22                                 PUNCHR
      IF(NTNT(K-1).LT.NTNT(K-2)) ISKIP1=ISKIP*2                           PUNCHR
      IF(NG(I,J-1).EQ.0) GO TO 150                                        PUNCHR
   26 IF(IDELT.EQ.1) GO TO 502
      IF(NPOP.EQ.1) GO TO 82
      PUNCH 902,IEID,IPID,NG(I-ISKIP,J),NG(I-2*ISKIP,J),NG(I-ISKIP1,J-1)  PUNCHR
     1,TH                                                                 PUNCHR
      WRITE(6,903) IEID,IPID,NG(I-ISKIP,J),NG(I-2*ISKIP,J),NG(I-ISKIP1,J
     1-1),TH
      IF(NPOP.EQ.0) GO TO 92                                              PUNCHR
   82 PUNCH 904,IEID,NG(I-ISKIP,J),NG(I-2*ISKIP,J),NG(I-ISKIP1,J-1),TH,   PUNCHR
     1MID                                                                 PUNCHR
      WRITE(6,905) IEID,NG(I-ISKIP,J),NG(I-2*ISKIP,J),NG(I-ISKIP1,J-1),   PUNCHR
     1TH,MID                                                              PUNCHR
      GO TO 92
  502 G3 = NG(I-ISKIP1,J-1)
      G2 = NG(I-2*ISKIP,J)
      G1 = NG(I-ISKIP,J)
      IF(G3.EQ.0) GO TO 150
      IF(NG(I,J-1).EQ.0) GO TO 150
      CALL WEDGE(G1,G2,G3,DELGP,KK,MID,IEID,ICLOSE,NDT,NPOP,J)
   92 IEID = IEID + 1                                                     PUNCHR
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      IF(IDELT.EQ.1) GO TO 503
      IF(NPOP.EQ.1) GO TO 83                                                PUNCHR
      PUNCH 902,IEID,IPID,NG(I-ISKIP1,J-1),NG(I,J-1),NG(I-ISKIP,J),TH       PUNCHR
      WRITE(6,903) IEID,IPID,NG(I-ISKIP1,J-1),NG(I,J-1),NG(I-ISKIP,J),TH    PUNCHR
      IF(NPOP.EQ.0) GO TO 93                                                PUNCHR
   83 PUNCH 904,IEID,NG(I-ISKIP1,J-1),NG(I,J-1),NG(I-ISKIP,J),TH,MID        PUNCHR
      WRITE(6,905) IEID,NG(I-ISKIP1,J-1),NG(I,J-1),NG(I-ISKIP,J),TH,MID     PUNCHR
      GO TO 93
  503 G3 = NG(I-ISKIP,J)
      G2 = NG(I,J-1)
      G1 = NG(I-ISKIP1,J-1)
      CALL WEDGE(G1,G2,G3,DELGP,KK,MID,IEID,ICLOSE,NDT,NPOP,J)
   93 IEID = IEID+1                                                         PUNCHR
      IF(IDELT.EQ.1) GO TO 504
      IF(NPOP.EQ.1) GO TO 84                                                PUNCHR
      PUNCH 902,IEID,IPID,NG(I,J-1),NG(I,J),NG(I-ISKIP,J),TH                PUNCHR
      WRITE(6,903) IEID,IPID,NG(I,J-1),NG(I,J),NG(I-ISKIP,J),TH             PUNCHR
      IF(NPOP.EQ.0) GO TO 94                                                PUNCHR
   84 PUNCH 904,IEID,NG(I,J-1),NG(I,J),NG(I-ISKIP,J),TH,MID                 PUNCHR
      WRITE(6,905) IEID,NG(I,J-1),NG(I,J),NG(I-ISKIP,J),TH,MID              PUNCHR
      GO TO 94
  504 G3 = NG(I-ISKIP,J)
      G2 = NG(I,J)
      G1 = NG(I,J-1)
      CALL WEDGE(G1,G2,G3,DELGP,KK,MID,IEID,ICLOSE,NDT,NPOP,J)
   94 IEID = IEID + 1                                                       PUNCHR
      GO TO 150                                                             PUNCHR
   22 ISKIP1=ISKIP/2                                                        PUNCHR
   28 IF(IDELT.EQ.1) GO TO 505
      IF(NPOP.EQ.1) GO TO 85
      PUNCH 902,IEID,IPID,NG(I-2*ISKIP1,J-1),NG(I-ISKIP1,J-1),NG(I-ISKIP
     1,J),TH
      WRITE(6,903) IEID,IPID,NG(I-2*ISKIP1,J-1),NG(I-ISKIP1,J-1),NG(I-IS
     1KIP,J),TH
      IF(NPOP.EQ.0) GO TO 95                                                PUNCHR
   85 PUNCH 904,IEID,NG(I-2*ISKIP1,J-1),NG(I-ISKIP1,J-1),NG(I-ISKIP,J),    PUNCHR
     1TH,MID                                                                PUNCHR
      WRITE(6,905) IEID,NG(I-2*ISKIP1,J-1),NG(I-ISKIP1,J-1),NG(I-ISKIP,J
     1),TH,MID
      GO TO 95
  505 G3 = NG(I-ISKIP,J)
      G2 = NG(I-ISKIP1,J-1)
      G1 = NG(I-2*ISKIP1,J-1)
      IF(G1.EQ.0) GO TO 150
      IF(G2.EQ.0) GO TO 150
      CALL WEDGE(G1,G2,G3,DELGP,KK,MID,IEID,ICLOSE,NDT,NPOP,J)
   95 IEID = IEID + 1                                                       PUNCHR
      IF(IDELT.EQ.1) GO TO 506
      IF(NPOP.EQ.1) GO TO 86                                                PUNCHR
      PUNCH 902,IEID,IPID,NG(I-ISKIP1,J-1),NG(I,J),NG(I-ISKIP,J),TH         PUNCHR
      WRITE(6,903) IEID,IPID,NG(I-ISKIP1,J-1),NG(I,J),NG(I-ISKIP,J),TH      PUNCHR
      IF(NPOP.EQ.0) GO TO 96                                                PUNCHR
   86 PUNCH 904,IEID,NG(I-ISKIP1,J-1),NG(I,J),NG(I-ISKIP,J),TH,MID          PUNCHR
      WRITE(6,905) IEID,NG(I-ISKIP1,J-1),NG(I,J),NG(I-ISKIP,J),TH,MID       PUNCHR
      GO TO 96
  506 G3 = NG(I-ISKIP,J)
      G2 = NG(I,J)
      G1 = NG(I-ISKIP1,J-1)
      CALL WEDGE(G1,G2,G3,DELGP,KK,MID,IEID,ICLOSE,NDT,NPOP,J)
   96 IEID = IEID + 1                                                       PUNCHR
      IF(IDELT.EQ.1) GO TO 507
      IF(NPOP.EQ.1) GO TO 87
      PUNCH 902,IEID,IPID,NG(I-ISKIP1,J-1),NG(I,J-1),NG(I,J),TH             PUNCHR
      WRITE(6,903) IEID,IPID,NG(I-ISKIP1,J-1),NG(I,J-1),NG(I,J),TH          PUNCHR
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      IF(NPOP.EQ.0) GO TO 97                                              PUNCHF
   87 PUNCH 904,IEID,NG(I-ISKIP1,J-1),NG(I,J-1),NG(I,J),TH,MID            PUNCHF
      WRITE(6,905) IEID,NG(I-ISKIP1,J-1),NG(I,J-1),NG(I,J),TH,MID         PUNCHF
      GO TO 97
  507 G3 = NG(I,J)
      G2 = NG(I,J-1)
      G1 = NG(I-ISKIP1,J-1)
      CALL WEDGE(G1,G2,G3,DELGP,KK,MID,IEID,ICLOSE,NDT,NPOP,J)
   97 IEID = IEID + 1                                                     PUNCHF
      GO TO 150                                                           PUNCHF
   21 IF(NTNT(K-1).GT.INTN) GO TO 24                                      PUNCHF
      IF(NTNT(K-1).LT.INTN) ISKIP1=ISKIP*2                                PUNCHF
      IF(NG(I,J-1).EQ.0) GO TO 150                                        PUNCHF
      GO TO 26                                                            PUNCHF
   24 ISKIP1 = ISKIP/2                                                    PUNCHF
      GO TO 28                                                            PUNCHF
  150 IFLAST=IEID                                                         PUNCHF
  170 CONTINUE                                                            PUNCHF
      IF(NPO.EQ.0) GO TO 200                                              PUNCHF
      JP=JMAX+1                                                           PUNCHF
      NG(1,JP)=NGS                                                        PUNCHF
      IF(NGP.EQ.1) GO TO 105
      IF(IDFLT.EQ.1) GO TO 510
      IF(NPS.GT.0) GO TO 71
      PUNCH 910,NG(1,JP),NCP,X(1,JP),Y,Z(1,JP),NCD
      WRITE(6,911) NG(1,JP),NCP,X(1,JP),Y,Z(1,JP),NCD
      GO TO 105
   71 PUNCH 900,NG(1,JP),NCP,X(1,JP),Y,Z(1,JP),NCD,NPS
      WRITE(6,901) NG(1,JP),NCP,X(1,JP),Y,Z(1,JP),NCD,NPS
      GO TO 105
  510 II = 1
      TH1 = THETA(II)
  511 IF(NPS.GT.0) GO TO 74
      PUNCH 910,NG(1,JP),NCP1,X(1,JP),TH1,Z(1,JP),NCP1
      WRITE(6,911) NG(1,JP),NCP1,X(1,JP),TH1,Z(1,JP),NCP1
      GO TO 72
   74 PUNCH 900,NG(1,JP),NCP1,X(1,JP),TH1,Z(1,JP),NCP1,NPS
      WRITE(6,901) NG(1,JP),NCP1,X(1,JP),TH1,Z(1,JP),NCP1,NPS
   72 IF(TH1.EQ.THETA(II+1)) II=II+1
      IF(TH1.EQ.THETA(NDT+1)) GO TO 100
      DTHETA = (THETA(II+1)-THETA(II))/(KK(II+1)-KK(II))
      NG(1,JP) = NG(1,JP) + 1
      TH1 = TH1 + DTHETA
      IF(TH1.EQ.360.0) GO TO 100
      GO TO 511
  100 IF(IDFLT.EQ.1) NG(1,JP) = NG(1,JP) - KK(NDT+1) + 1
  105 NGLAST=NG(1,JP) + 1
      MAX=MAXI-1                                                          PUNCHR
      DO 60 I=MINI,MAX,ISKIP                                              PUNCHR
      IF(IDFLT.EQ.1) GO TO 508
      IF(NPOP.EQ.1) GO TO 88                                              PUNCHR
      PUNCH 902,IEID,IPID,NG(I+ISKIP,JMAX),NG(1,JP),NG(I,JMAX),TH         PUNCHR
      WRITE(6,903) IEID,IPID,NG(I+ISKIP,JMAX),NG(1,JP),NG(I,JMAX),TH      PUNCHR
      IF(NPOP.EQ.0) GO TO 60                                              PUNCHR
   88 PUNCH 904,IEID,NG(I+ISKIP,JMAX),NG(1,JP),NG(I,JMAX),TH,MID          PUNCHR
      WRITE(6,905) IEID,NG(I+ISKIP,JMAX),NG(1,JP),NG(I,JMAX),TH,MID       PUNCHR
      GO TO 60
  508 G3 = NG(I,JMAX)
      G2 = NG(1,JP)
      G1 = NG(I+ISKIP,JMAX)
      J = JP
      CALL WEDGE(G1,G2,G3,DELGP,KK,MID,IEID,ICLOSE,NDT,NPOP,J)
   60 IEID=IEID+1                                                         PUNCHR
      IELAST=IEID                                                         PUNCHR
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      IF(IDELT.EQ.1) NGLAST = NGLAST + MAD
  200 CONTINUE                                                          PUNCHR
      JMAXJ1 = JMAXJ
      JMINJ1=JMINJ                                                      PUNCHR
  400 FORMAT(I5)                                                        PUNCHR
  402 FORMAT(2I5)                                                       PUNCHR
  900 FORMAT(4HGRID,4X,2I8,3F8.4,2I8)
  901 FORMAT(5X,4HGRID,4X,2I8,3F8.4,2I8)
  902 FORMAT(6HCTRIA2,2X,5I8,F8.4)                                      PUNCHR
  903 FORMAT(5X,6HCTRIA2,2X,5I8,F8.4)                                   PUNCHR
  904 FORMAT(7HCTRIARG,1X,4I8,F8.4,I8)                                  PUNCHR
  905 FORMAT(5X,7HCTRIARG,1X,4I8,F8.4,I8)                               PUNCHR
  906 FORMAT(6HCQUAD2,2X,6I8,F8.4)
  907 FORMAT(5X,6HCQUAD2,2X,6I8,F8.4)
  908 FORMAT(7HCTRAPRG,1X,5I8,F8.4,I8)
  909 FORMAT(5X,7HCTRAPRG,1X,5I8,F8.4,I8)
  910 FORMAT(4HGRID,4X,2I8,3F8.4,I8)
  911 FORMAT(5X,4HGRID,4X,2I8,3F8.4,I8)
      RETURN                                                            PUNCHR
      END                                                               PUNCHR
      SUBROUTINE WEDGE(G1,G2,G3,DELGP,KK,MID,IEID,ICLOSE,NDT,NPOP,J)
      DIMENSION KK(10),X(30,30),Z(30,30),NG(30,30),NGF(30,30),CODE(30,30
     1),KSKIP(30,30),JB(10),JE(10),BETA(10),THETA(10),IMIN(30),IMAX(30)
      INTEGER G1,G2,G3,G4,G5,G6,DELGP
      COMMON X,Z,NG,CODE,NGF,KSKIP,NSECT,JB,JE,BETA,THETA,IMIN,IMAX,JMAX
     11,JMIN1
      COMMON MPC,IU(2),JU(2),IM(2),JM(2),IL(2),JL(2),ICON,LS(2)
      COMMON ICONST(2),JCONST(2)
C *** THIS SUBROUTINE PUNCHES THE SOLID ELEMENT CONNECTION CARDS
C *** (CWEDGE) AND CROD + CTRIA2 CARDS FOR DISPLAY ON GRID .
      T = 0.0
      IBEG = IEID
      G4 = G1 + 1
      G5 = G2 + 1
      G6 = G3 + 1
      IF(ICLOSE.EQ.0) GO TO 100
      GO TO 101
  100 IG1 = G1
      IG2 = G2
      IG3 = G3
  101 JJ = KK(NDT+1) - 1
      I = 1
      IJ = 1
      TH1 = THETA(I)
      DO 99 L=1,JJ
      IF(TH1.GE.BETA(IJ).AND.TH1.LT.BETA(IJ+1)) GO TO 300
      IJ = IJ + 1
  300 IF(J.LE.JB(IJ).OR.J.GT.JE(IJ)) GO TO 105
      IF(NPOP.EQ.4) GO TO 200
      PUNCH 600,IEID,MID,G1,G2,G3,G4,G5,G6
      WRITE(6,601) IEID,MID,G1,G2,G3,G4,G5,G6
      IF(NPOP.EQ.3) GO TO 105
  200 ID = IEID
      IE = ID+ DELGP
      IF(NSECT.GT.1) GO TO 120
      IF(L.GT.1) GO TO 110
      IF(L.EQ.JJ.AND.ICLOSE.EQ.0) GO TO 111
  120 PUNCH 800,ID,ID,G1,G2,G3,T
  110 PUNCH 800,IE,IE,G4,G5,G6,T
  111 ID = IE + DELGP
      IF = ID + DELGP
      PUNCH 700,ID,ID,G1,G4,IE,IE,G2,G5
      ID = IF + DELGP
      PUNCH 700,ID,ID,G3,G6
```

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105 G1 = G4
    G2 = G5
    G3 = G6
    G4 = G4 + 1
    G5 = G5 + 1
    G6 = G6 + 1
    IFID = IFID + DELGP
    IF(TH1.EQ.THETA(I+1)) I=I+1
    DTHETA = (THETA(I +1)-THETA(I ))/(KK(I +1)-KK(I ))
    TH1 = TH1 + DTHETA
    IF(L.EQ.JJ-1.AND.ICLOSE.EQ.0) GO TO 103
    GO TO 99
103 G4 = IG1
    G5 = IG2
    G6 = IG3
 99 CONTINUE
    IFID = IBEG
600 FORMAT(6HCWEDGE,2X,8I8)
601 FORMAT(5X,6HCWEDGE,2X,8I8)
700 FORMAT(4HCROD,4X,8I8)
701 FORMAT(5X,4HCROD,4X,8I8)
800 FORMAT(6HCTRIA2,2X,5I8,F8.4)
    RETURN
    END
    SUBROUTINE MPCP(ML,NCALL,I,J,NDT,KK,IFIX,MAXI,JMAX)
    INTEGER CZ(5),CN(5),CO(5),CT(5),CB(5),CZM(5),CNM(5),COM(5),CTM(5),
   1CBM(5),C(5),CM(5),A,B,E,F,G,H,P,Q
    INTEGER CZ1(5),CN1(5),CO1(5),CT1(5),CB1(5),CZM1(5),CNM1(5),COM1(5)
   1,CTM1(5),CBM1(5)
    INTEGER CZ2(5),CN2(5),CO2(5),CT2(5),CB2(5),CZM2(5),CNM2(5),COM2(5)
   1,CTM2(5),CBM2(5)
    DIMENSION X(30,30),S(30,30),NT(10),NG(30,30),DELTZ(10),CODE(30,30)
    DIMENSION NGF(30,30),KSKIP(30,30),KK(10),THETA(10),JB(10),JE(10)
   1,BETA(10),IMIN(30),IMAX(30),TITLE(13)
    COMMON X,S,NG,CODE,NGF,KSKIP,NSECT,JB,JE,BETA,THETA,IMIN,IMAX,JMAX
   11,JMIN1
    COMMON MPC,IU(2),JU(2),IM(2),JM(2),IL(2),JL(2),ICON,LS(2)
    COMMON ICONST(2),JCONST(2)
    DATA F/1H1/, G/1H2/, H/1H3/, P/1H5/, Q/1H6/
    NCP = 1
    IPUN = 0
    IF(IFIX.EQ.4) GO TO 300
    IF(ML.EQ.1.AND.NCALL.EQ.0) GO TO 6
    IF(ML.EQ.2.AND.NCALL.EQ.0) GO TO 7
    IF(ML.EQ.2.AND.NCALL.EQ.1) GO TO 7
    GO TO 9
  6 NCALL = 1
    GO TO 10
  7 NCALL = 2
    GO TO 220
 10 READ(5,120) (CZ1(KA),KA=1,5),(CN1(KB),KB=1,5),(CO1(KC),KC=1,5),(CT
   11(KD),KD=1,5),(CB1(KE),KE=1,5),(CZM1(KF),KF=1,5), (CNM1(KG),KG=1,5
   2),(COM1(KH),KH=1,5),(CTM1(KI),KI=1,5),(CBM1(KJ),KJ=1,5)
    IF(LS(1).EQ.LS(2)) GO TO 221
    GO TO 9
221 NCALL = 2
220 READ(5,120) (CZ2(KA),KA=1,5),(CN2(KB),KB=1,5),(CO2(KC),KC=1,5),(CT
   12(KD),KD=1,5),(CB2(KE),KE=1,5),(CZM2(KF),KF=1,5), (CNM2(KG),KG=1,5
   2),(COM2(KH),KH=1,5),(CTM2(KI),KI=1,5),(CBM2(KJ),KJ=1,5)
  9 IF(ML.EQ.2) GO TO 222
    DO 225 L=1,5
    CZ(L) = CZ1(L)
    CN(L) = CN1(L)
    CO(L) = CO1(L)
```

```
      CT(L) = CT1(L)
      CB(L) = CB1(L)
      CZM(L) = CZM1(L)
      CNM(L) = CNM1(L)
      COM(L) = COM1(L)
      CTM(L) = CTM1(L)
  225 CBM(L) = CBM1(L)
      GO TO 230
  222 DO 235 L=1,5
      CZ(L) = CZ2(L)
      CN(L) = CN2(L)
      CO(L) = CO2(L)
      CT(L) = CT2(L)
      CB(L) = CB2(L)
      CZM(L) = CZM2(L)
      CNM(L) = CNM2(L)
      COM(L) = COM2(L)
      CTM(L) = CTM2(L)
  235 CBM(L) = CBM2(L)
  230 IF(IU(ML).EQ.I.AND.JU(ML).EQ.J) GO TO 5
      IF(IL(ML).EQ.I.AND.JL(ML).EQ.J) GO TO 8
      II = 1
      TH1 = THETA(II)
   20 IF(TH1.EQ.0.0) GO TO 11
      IF(TH1.EQ.90.0) GO TO 12
      IF(TH1.EQ.180.0) GO TO 13
      IF(TH1.EQ.270.0) GO TO 14
      PUNCH 100,NG(I,J),NCP,X(I,J),TH1,S(I,J),NCP,(CBM(L),L=1,5)
      WRITE(6,101) NG(I,J),NCP,X(I,J),TH1,S(I,J),NCP,(CBM(L),L=1,5)
      GO TO 15
   11 PUNCH 100,NG(I,J),NCP,X(I,J),TH1,S(I,J),NCP,(CZM(L),L=1,5)
      WRITE(6,101) NG(I,J),NCP,X(I,J),TH1,S(I,J),NCP,(CZM(L),L=1,5)
      GO TO 15
   12 PUNCH 100,NG(I,J),NCP,X(I,J),TH1,S(I,J),NCP,(CNM(L),L=1,5)
      WRITE(6,101) NG(I,J),NCP,X(I,J),TH1,S(I,J),NCP,(CNM(L),L=1,5)
      GO TO 15
   13 PUNCH 100,NG(I,J),NCP,X(I,J),TH1,S(I,J),NCP,(COM(L),L=1,5)
      WRITE(6,101) NG(I,J),NCP,X(I,J),TH1,S(I,J),NCP,(COM(L),L=1,5)
      GO TO 15
   14 PUNCH 100,NG(I,J),NCP,X(I,J),TH1,S(I,J),NCP,(CTM(L),L=1,5)
      WRITE(6,101) NG(I,J),NCP,X(I,J),TH1,S(I,J),NCP,(CTM(L),L=1,5)
   15 GO TO 94
  300 ID = 1
      IA=1
      IB=2
      IC=3
      IF=5
      IE=6
      Z=1.0
      D=-1.0
      ISAVE = I
      JSAVE = J
      II = 1
      TH1 = THETA(II)
      NG(IM(ML),JM(ML)) = NG(IM(ML),JM(ML))
      NG(IL(ML),JL(ML)) = NG(IL(ML),JL(ML))
      NG(IU(ML),JU(ML)) = NG(IU(ML),JU(ML))
  330 A=B=E=0
      IF(TH1.EQ.0.0) GO TO 301
      IF(TH1.EQ.90.0) GO TO 302
      IF(TH1.EQ.180.0) GO TO 303
      IF(TH1.EQ.270.0) GO TO 304
      DO 25 K=1,5
      C(K) =CB(K)
```

```
 25 CM(K) =CBM(K)
    GO TO 325
301 DO 26 K=1,5
    C(K) = CZ(K)
 26 CM(K) = CZM(K)
    GO TO 325
302 DO 30 K=1,5
    C(K) = CN(K)
 30 CM(K) = CNM(K)
    GO TO 325
303 DO 31 K=1,5
    C(K) = CO(K)
 31 CM(K) = COM(K)
    GO TO 325
304 DO 32 K=1,5
    C(K) = CT(K)
 32 CM(K) = CTM(K)
325 I = IM(ML)
    J = JM(ML)
    RU = X(IU(ML),JU(ML)) - X(I,J)
    RL = X(IL(ML),JL(ML)) - X(I,J)
    RR = X(I,J)-X(IU(ML),JU(ML))
    RS = X(I,J) - X(IL(ML),JL(ML))
    DO 40 M=1,5
    IF(CM(M).EQ.F) A=1
    IF(CM(M).EQ.G) B=1
 40 IF(CM(M).EQ.H) E=1
    IF(B.EQ.1) GO TO 45
    GO TO 46
 61 IF(E.EQ.1) GO TO 50
    GO TO 51
 45 DO 60 N=1,5
 60 IF(CM(N).EQ.Q) B=2
    GO TO 61
 46 DO 65 LN=1,5
 65 IF(CM(LN).EQ.Q) B=3
    GO TO 61
 50 DO 75 KL=1,5
 75 IF(CM(KL).EQ.P) E=2
    GO TO 64
 51 DO 76 LK=1,5
 76 IF(CM(LK).EQ.P) E=3
 64 DO 62 LM=1,5
    IF(C(LM).EQ.F) A=1
    IF(C(LM).EQ.G.AND.B.EQ.1) B=2
    IF(C(LM).EQ.G.AND.B.EQ.3) B=2
    IF(C(LM).EQ.H.AND.E.EQ.1) E=2
 62 IF(C(LM).EQ.H.AND.E.EQ.3) E=2
    IF(A.EQ.1) GO TO 80
    PUNCH 105,ID,NG(IU(ML),JU(ML)),IA,Z,NG(I,J),IA,D
    WRITE(6,106) ID,NG(IU(ML),JU(ML)),IA,Z,NG(I,J),IA,D
    PUNCH 105,ID,NG(IL(ML),JL(ML)),IA,Z,NG(I,J),IA,D
    WRITE(6,106) ID,NG(IL(ML),JL(ML)),IA,Z,NG(I,J),IA,D
 80 IF(B.EQ.0) GO TO 81
    IF(B.EQ.1) GO TO 82
    IF(B.EQ.3) GO TO 83
    GO TO 84
 81 PUNCH 109,ID,NG(IU(ML),JU(ML)),IB,Z,NG(I,J),IE,RR,ICON
    WRITE(6,110) ID,NG(IU(ML),JU(ML)),IB,Z,NG(I,J),IE,RR,ICON
    PUNCH 107,ICON,NG(I,J),IB,D
    WRITE(6,108) ICON,NG(I,J),IB,D
    ICON = ICON + 1
    PUNCH 109,ID,NG(IL(ML),JL(ML)),IB,Z,NG(I,J),IE,RS,ICON
    WRITE(6,110) ID,NG(IL(ML),JL(ML)),IB,Z,NG(I,J),IE,RS,ICON
```

```
      PUNCH 107,ICON,NG(I,J),IB,D
      WRITE(6,108) ICON,NG(I,J),IB,D
      ICON = ICON + 1
      GO TO 84
   82 PUNCH 105,ID,NG(IU(ML),JU(ML)),IB,Z,NG(I,J),IE,RR
      WRITE(6,106) ID,NG(IU(ML),JU(ML)),IB,Z,NG(I,J),IE,RR
      PUNCH 105,ID,NG(IL(ML),JL(ML)),IB,Z,NG(I,J),IE,RS
      WRITE(6,106) ID,NG(IL(ML),JL(ML)),IB,Z,NG(I,J),IE,RS
      GO TO 84
   83 PUNCH 105,ID,NG(IU(ML),JU(ML)),IB,Z,NG(I,J),IB,D
      WRITE(6,106) ID,NG(IU(ML),JU(ML)),IB,Z,NG(I,J),IB,D
      PUNCH 105,ID,NG(IL(ML),JL(ML)),IB,Z,NG(I,J),IB,D
      WRITE(6,106) ID,NG(IL(ML),JL(ML)),IB,Z,NG(I,J),IB,D
   84 CONTINUE
      IF(E.EQ.0) GO TO 91
      IF(E.EQ.1) GO TO 92
      IF(E.EQ.3) GO TO 93
      GO TO 94
   91 PUNCH 109,ID,NG(IU(ML),JU(ML)),IC,Z,NG(I,J),IF,RU,ICON
      WRITE(6,110) ID,NG(IU(ML),JU(ML)),IC,Z,NG(I,J),IF,RU,ICON
      PUNCH 107,ICON,NG(I,J),IC,D
      WRITE(6,108) ICON,NG(I,J),IC,D
      ICON = ICON + 1
      PUNCH 109,ID,NG(IL(ML),JL(ML)),IC,Z,NG(I,J),IF,RL,ICON
      WRITE(6,110) ID,NG(IL(ML),JL(ML)),IC,Z,NG(I,J),IF,RL,ICON
      PUNCH 107,ICON,NG(I,J),IC,D
      WRITE(6,108) ICON,NG(I,J),IC,D
      ICON = ICON + 1
      GO TO 94
   92 PUNCH 105,ID,NG(IU(ML),JU(ML)),IC,Z,NG(I,J),IF,RU
      WRITE(6,106) ID,NG(IU(ML),JU(ML)),IC,Z,NG(I,J),IF,RU
      PUNCH 105,ID,NG(IL(ML),JL(ML)),IC,Z,NG(I,J),IF,RL
      WRITE(6,106) ID,NG(IL(ML),JL(ML)),IC,Z,NG(I,J),IF,RL
      GO TO 94
   93 PUNCH 105,ID,NG(IU(ML),JU(ML)),IC,Z,NG(I,J),IC,D
      WRITE(6,106) ID,NG(IU(ML),JU(ML)),IC,Z,NG(I,J),IC,D
      PUNCH 105,ID,NG(IL(ML),JL(ML)),IC,Z,NG(I,J),IC,D
      WRITE(6,106) ID,NG(IL(ML),JL(ML)),IC,Z,NG(I,J),IC,D
   94 CONTINUE
      IF(TH1.EQ.THETA(II+1)) II=II+1
      IF(TH1.EQ.THETA(NDT+1)) GO TO 70
      DTHETA = (THETA(II+1)-THETA(II))/(KK(II+1)-KK(II))
      NG(I,J)=NG(I,J)+1
      NG(IU(ML),JU(ML))=NG(IU(ML),JU(ML)) + 1
      NG(IL(ML),JL(ML))=NG(IL(ML),JL(ML)) + 1
      TH1=TH1 + DTHETA
      IF(TH1.EQ.360.0) GO TO 70
      IF(IFIX.EQ.4) GO TO 330
      IF(IPUN.EQ.1) GO TO 330
      GO TO 20
   70 NG(I,J) = NG(I,J) - (KK(NDT+1)-1)
      NG(IU(ML),JU(ML)) = NG(IU(ML),JU(ML))-(KK(NDT+1)-1)
      NG(IL(ML),JL(ML)) = NG(IL(ML),JL(ML))-(KK(NDT+1)-1)
      GO TO 210
    5 CONTINUE
    8 CONTINUE
      II = 1
      TH1 = THETA(II)
  125 IF(TH1.EQ.0.0) GO TO 130
      IF(TH1.EQ.90.0) GO TO 131
      IF(TH1.EQ.180.0) GO TO 132
      IF(TH1.EQ.270.0) GO TO 133
      PUNCH 100,NG(I,J),NCP,X(I,J),TH1,S(I,J),NCP,(CB(L),L=1,5)
      WRITE(6,101) NG(I,J),NCP,X(I,J),TH1,S(I,J),NCP,(CB(L),L=1,5)
```

```
      GO TO 201
  130 PUNCH 100,NG(I,J),NCP,X(I,J),TH1,S(I,J),NCP,(CZ(L),L=1,5)
      WRITE(6,101) NG(I,J),NCP,X(I,J),TH1,S(I,J),NCP,(CZ(L),L=1,5)
      GO TO 201
  131 PUNCH 100,NG(I,J),NCP,X(I,J),TH1,S(I,J),NCP,(CN(L),L=1,5)
      WRITE(6,101) NG(I,J),NCP,X(I,J),TH1,S(I,J),NCP,(CN(L),L=1,5)
      GO TO 201
  132 PUNCH 100,NG(I,J),NCP,X(I,J),TH1,S(I,J),NCP,(CO(L),L=1,5)
      WRITE(6,101) NG(I,J),NCP,X(I,J),TH1,S(I,J),NCP,(CO(L),L=1,5)
      GO TO 201
  133 PUNCH 100,NG(I,J),NCP,X(I,J),TH1,S(I,J),NCP,(CT(L),L=1,5)
      WRITE(6,101) NG(I,J),NCP,X(I,J),TH1,S(I,J),NCP,(CT(L),L=1,5)
  201 CONTINUE
      IF(TH1.EQ.THETA(II+1)) II=II+1
      IF(TH1.EQ.THETA(NDT+1)) GO TO 205
      DTHETA = (THETA(II+1)-THETA(II))/(KK(II+1)-KK(II))
      NG(I,J)=NG(I,J)+1
      TH1=TH1 + DTHETA
      IF(TH1.EQ.360.0) GO TO 205
      GO TO 125
  210 CONTINUE
      IF(I.EQ.IM(ML).AND.J.EQ.JM(ML)) GO TO 360
  205 NG(I,J) = NG(I,J) - (KK(NDT+1) - 1)
      GO TO 400
  360 CONTINUE
      IF(IFIX.NE.4) GO TO 400
      I = ISAVE
      J = JSAVE
  400 CONTINUE
      IF(IPUN.EQ.1) GO TO 425
      IF(I.EQ.MAXI.AND.J.EQ.JMAX) GO TO 410
      GO TO 411
  410 IF(IPUN.EQ.0) GO TO 420
      GO TO 411
  420 IPUN = 1
      GO TO 300
  425 I = ISAVE
      J = JSAVE
  411 CONTINUE
  100 FORMAT(4HGRID,4X,2I8,3F8.3,I8,3X,5A1)
  101 FORMAT(5X,4HGRID,4X,2I8,3F8.3,I8,3X,5A1)
  105 FORMAT(3HMPC,5X,3I8,F8.3,2I8,F8.3)
  106 FORMAT(5X,3HMPC,5X,3I8,F8.3,2I8,F8.3)
  107 FORMAT(1H+,I3,12X,2I8,F8.3)
  108 FORMAT(5X,1H+,I3,12X,2I8,F8.3)
  109 FORMAT(3HMPC,5X,3I8,F8.3,2I8,F8.3,8X,1H+,I3)
  110 FORMAT(5X,3HMPC,5X,3I8,F8.3,2I8,F8.3,8X,1H+,I3)
  120 FORMAT(50A1)
      RETURN
      END
```

APPENDIX B

DEMONSTRATION PROBLEMS

This appendix presents eight sample problems. Each one demonstrates some of the important features of JIG. Each of the following problems gives a statement emphasizing these important features, the mesh planning and preparation of data, the input and output listings, and a hardcopy of the structural plot.

B-I. Triangular Membrane and Bending, Axisymmetric Triangular Ring, and 3-D Solid Elements - featuring CTRIA2, CTRIARG and CWEDGE finite element structural models.

B-II. Variable Cross-Section's - featuring solid wedge finite element model having variable cross section.

B-III. Repeated sections - featuring repeated sections used in a threaded joint.

B-IV. Variable Theta - featuring variable theta options for CWEDGE structural finite element models.

B-V. Prescribed Points and Lines - featuring prescribed point and line options. (Applies to a cross section).

B-VI. Transition -featuring combinations of increasing and decreasing the mesh size of a structural model (R-direction only).

B-VII. MPC Generator - featuring the generation of MPC cards for connection of solid wedge to plate elements.

B-VIII. Curved Boundary - featuring a nozzle using the curved boundary option.

PROBLEM B-I

TRIANGULAR MEMBRANE AND BENDING, AXISYMMETRIC TRIANGULAR RING AND 3-D SOLID ELEMENTS

The three following examples demonstrate the use of CTRIA2, CTRIARG and the CWEDGE options. Figure B-1, shows the planned finite element model and configuration of the cross-section of a solid ring. This model shall be used to demonstrate all three of the above options. In example B-I-A the CTRIA2 punch option is shown. The model, consisting of a constant thickness flat plate, was divided into five equal spaces in the I - Z direction and four equal spaces in the J - X or R direction. A complete listing of the data input is shown in Figure B-2. Figure B-3 shows the grid point and element identification numbers as generated by JIG. Figure B-4 gives a structural plot of the finite element model and is followed by a listing of the JIG punched output.

Example B-I-B demonstrates the CTRIARG option. Figure B-1 shows the planned finite element model and configuration of an axisymmetric ring. A complete listing of the data input is shown in Figure B-5. Figure B-6 shows the the grid point and element identification numbers as generated by JIG. Figure B-7 gives a structural plot of the finite element model and is followed by a listing of the JIG punched output.

In example B-I-C the CWEDGE punch option is shown. The planned finite element model and configuration of the solid 3-D element option is shown in Figure B-1. The model was divided into five equal spaces in the I - Z direction, four equal spaces in the J - X or R direction, and six equal spaces in the theta direction. A complete listing of the data input is shown in Figure B-8. Figures B-9 and B-10 show

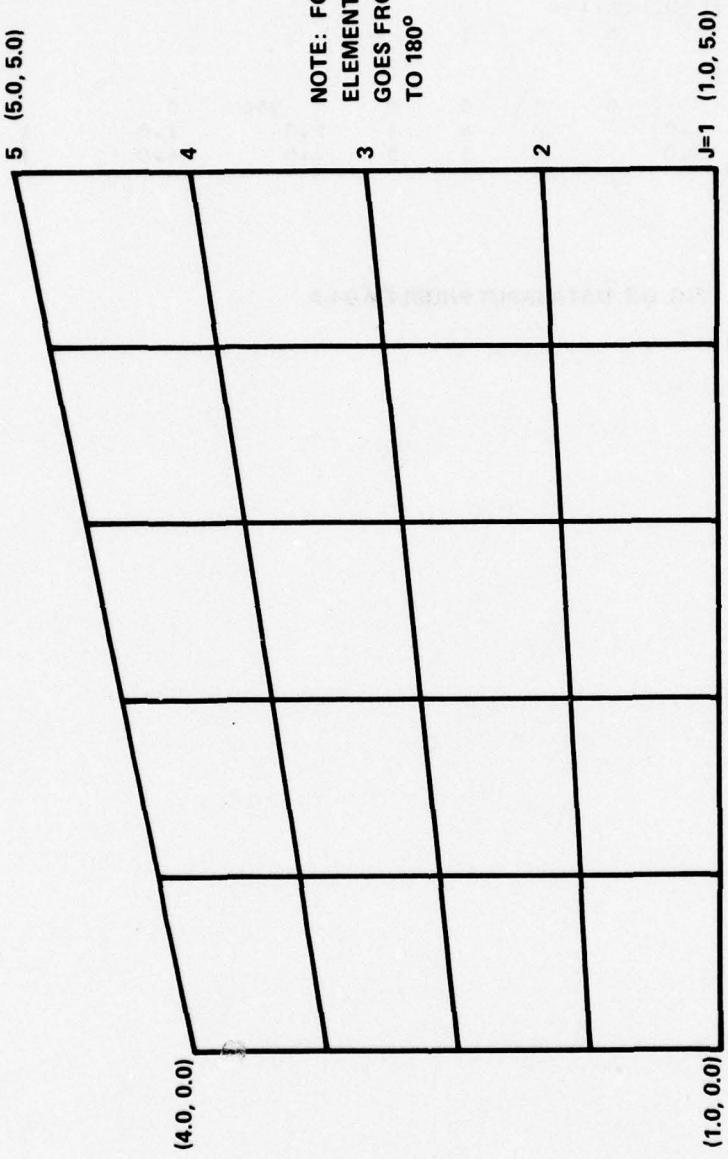


FIG. B-1 FINITE ELEMENT MODEL AND CONFIGURATION OF THE CROSS-SECTION OF A SOLID RING

```
*** SAMPLE 1 - PLATE ELEMENTS ***
   1     1     1     0     5     0     0     1
   1
  0.0
   4     1     5     1     6     0     0     0     0     0  456     0
   1     1   0.0         1.0         1     6     1   5.0           1.0          1
   6     5   5.0         5.0         1     1     5   0.0           4.0          1
```

FIG. B-2 DATA INPUT PROBLEM B-I-A

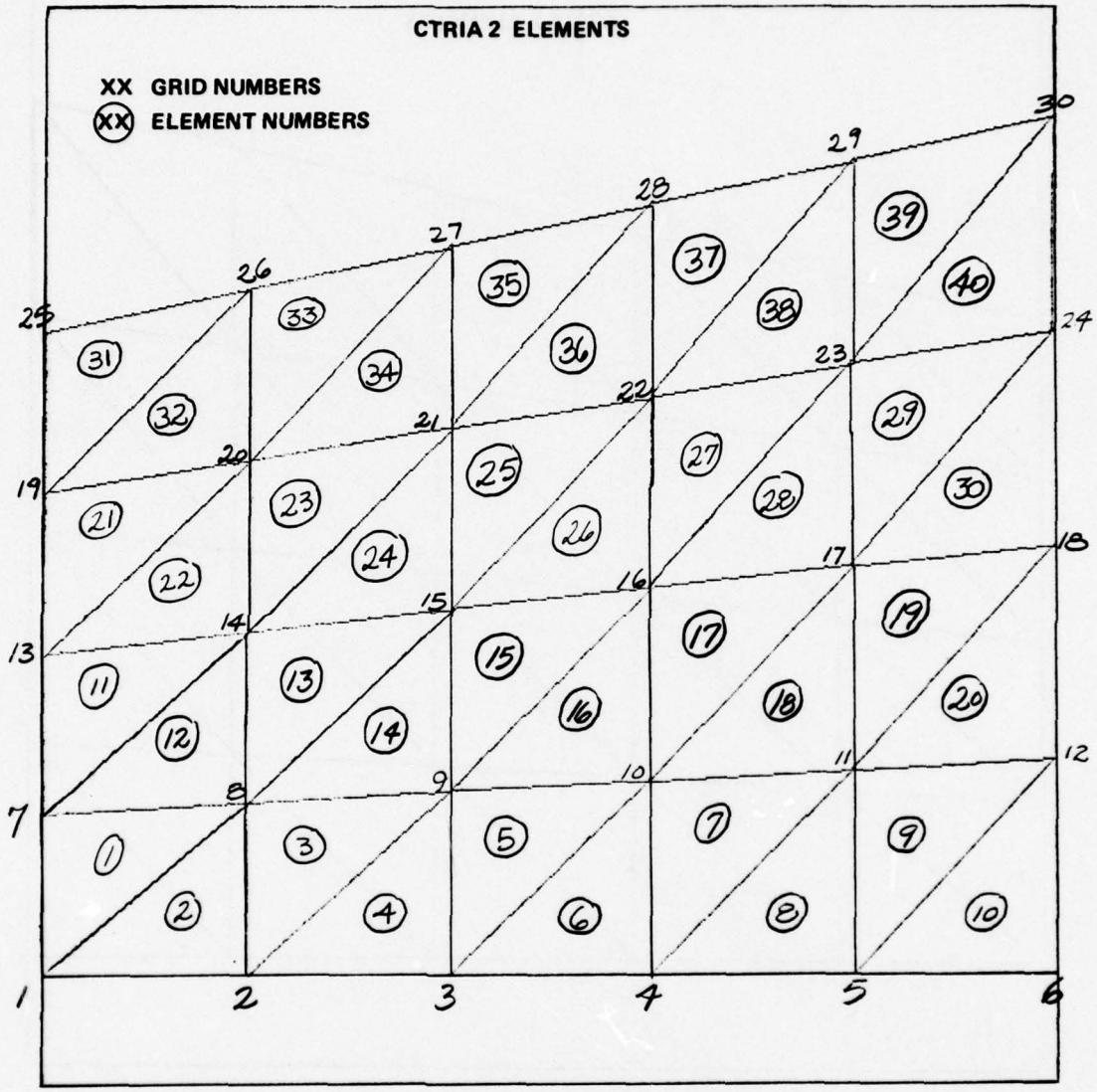


FIG. B-3 GRID POINT AND ELEMENT IDENTIFICATION NUMBERS

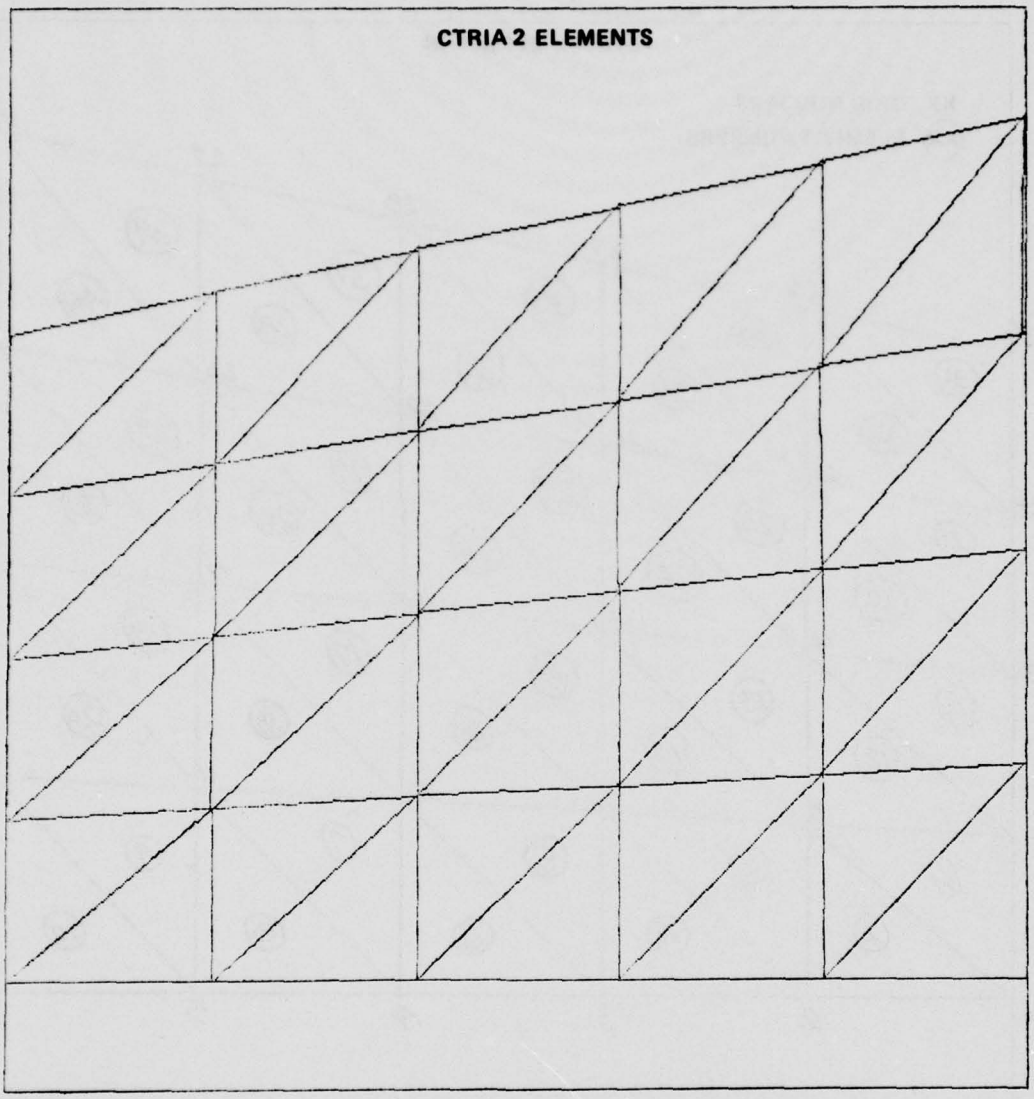


FIG. B-4 NASTRAN STRUCTURAL PLOT

LISTING OF PUNCHED NASTRAN BULK DATA CARDS
PROBLEM B-I-A TRIANGULAR MEMBRANE ELEMENTS

```
**************************************************
**************************************************
**                                              **
**   JUNCTION INPUT GENERATOR PROGRAM   (JIG)   **
**                                              **
**************************************************
**************************************************
```

*** SAMPLE 1 - PLATE ELEMENTS ***

```
NST =      1
NGS =      1
NES =      1
NPOP =     0
MID =      5
NGP =      0
IDELT =    0
NSECT =    1
NT( 1) =     1     DELTZ( 1) =     0.0000
```

I	J	Z(I,J)	X(I,J)	CODE(I,J)
1	1	0.00000	1.00000	1
2	1	1.00000	1.00000	1
3	1	2.00000	1.00000	1
4	1	3.00000	1.00000	1
5	1	4.00000	1.00000	1
6	1	5.00000	1.00000	1
1	2	0.00000	1.75000	1
2	2	1.00000	1.79999	0
3	2	2.00001	1.85002	0
4	2	3.00002	1.90000	0
5	2	3.99999	1.94998	0
6	2	5.00000	2.00000	1
1	3	0.00000	2.50000	1
2	3	1.00003	2.60002	0
3	3	2.00002	2.70002	0
4	3	3.00000	2.79999	0
5	3	4.00000	2.90000	0
6	3	5.00000	3.00000	1
1	4	0.00000	3.25000	1
2	4	1.00002	3.40002	0
3	4	1.99998	3.54999	0
4	4	3.00000	3.70000	0
5	4	4.00000	3.84999	0
6	4	5.00000	4.00000	1
1	5	0.00000	4.00000	1
2	5	1.00000	4.20000	1
3	5	2.00000	4.40000	1
4	5	3.00000	4.60000	1
5	5	4.00000	4.80000	1
6	5	5.00000	5.00000	1

```
GRID            1       0  1.0000  0.0000  0.0000       0      456
GRID            2       0  1.0000  0.0000  1.0000       0      456
GRID            3       0  1.0000  0.0000  2.0000       0      456
GRID            4       0  1.0000  0.0000  3.0000       0      456
GRID            5       0  1.0000  0.0000  4.0000       0      456
GRID            6       0  1.0000  0.0000  5.0000       0      456
GRID            7       0  1.7500  0.0000  0.0000       0      456
GRID            8       0  1.8000  0.0000  1.0000       0      456
CTRIA2          1       1       8       7       1  0.0000
CTRIA2          2       1       1       2       8  0.0000
GRID            9       0  1.8500  0.0000  2.0000       0      456
CTRIA2          3       1       9       8       2  0.0000
CTRIA2          4       1       2       3       9  0.0000
GRID           10       0  1.9000  0.0000  3.0000       0      456
CTRIA2          5       1      10       9       3  0.0000
CTRIA2          6       1       3       4      10  0.0000
GRID           11       0  1.9500  0.0000  4.0000       0      456
CTRIA2          7       1      11      10       4  0.0000
CTRIA2          8       1       4       5      11  0.0000
GRID           12       0  2.0000  0.0000  5.0000       0      456
CTRIA2          9       1      12      11       5  0.0000
CTRIA2         10       1       5       6      12  0.0000
GRID           13       0  2.5000  0.0000  0.0000       0      456
GRID           14       0  2.6000  0.0000  1.0000       0      456
CTRIA2         11       1      14      13       7  0.0000
CTRIA2         12       1       7       8      14  0.0000
GRID           15       0  2.7000  0.0000  2.0000       0      456
CTRIA2         13       1      15      14       8  0.0000
```

```
CTRIA2          14        1         8         9        15  0.0000
GRID            16        0  2.8000  0.0000  3.0000         0       456
CTRIA2          15        1        16        15         9  0.0000
CTRIA2          16        1         9        10        16  0.0000
GRID            17        0  2.9000  0.0000  4.0000         0       456
CTRIA2          17        1        17        16        10  0.0000
CTRIA2          18        1        10        11        17  0.0000
GRID            18        0  3.0000  0.0000  5.0000         0       456
CTRIA2          19        1        18        17        11  0.0000
CTRIA2          20        1        11        12        18  0.0000
GRID            19        0  3.2500  0.0000  0.0000         0       456
GRID            20        0  3.4000  0.0000  1.0000         0       456
CTRIA2          21        1        20        19        13  0.0000
CTRIA2          22        1        13        14        20  0.0000
GRID            21        0  3.5500  0.0000  2.0000         0       456
CTRIA2          23        1        21        20        14  0.0000
CTRIA2          24        1        14        15        21  0.0000
GRID            22        0  3.7000  0.0000  3.0000         0       456
CTRIA2          25        1        22        21        15  0.0000
CTRIA2          26        1        15        16        22  0.0000
GRID            23        0  3.8500  0.0000  4.0000         0       456
CTRIA2          27        1        23        22        16  0.0000
CTRIA2          28        1        16        17        23  0.0000
GRID            24        0  4.0000  0.0000  5.0000         0       456
CTRIA2          29        1        24        23        17  0.0000
CTRIA2          30        1        17        18        24  0.0000
GRID            25        0  4.0000  0.0000  0.0000         0       456
GRID            26        0  4.2000  0.0000  1.0000         0       456
CTRIA2          31        1        26        25        19  0.0000
CTRIA2          32        1        19        20        26  0.0000
GRID            27        0  4.4000  0.0000  2.0000         0       456
CTRIA2          33        1        27        26        20  0.0000
CTRIA2          34        1        20        21        27  0.0000
GRID            28        0  4.6000  0.0000  3.0000         0       456
CTRIA2          35        1        28        27        21  0.0000
CTRIA2          36        1        21        22        28  0.0000
GRID            29        0  4.8000  0.0000  4.0000         0       456
CTRIA2          37        1        29        28        22  0.0000
CTRIA2          38        1        22        23        29  0.0000
GRID            30        0  5.0000  0.0000  5.0000         0       456
CTRIA2          39        1        30        29        23  0.0000
CTRIA2          40        1        23        24        30  0.0000
```

```
*** SAMPLE 1 - AXISYMMETRIC RING ELEMENTS ***
   1     1     1     1     5     0     0     1
   1
  0.0
   4     1     5     1     6     0     0     0     0     0  456     0
   1     1   0.0         1.0           1     6     1     5.0         1.0          1
   6     5   5.0         5.0           1     1     5     0.0         4.0          1
```

FIG B-5 DATA INPUT PROBLEM B-I-B

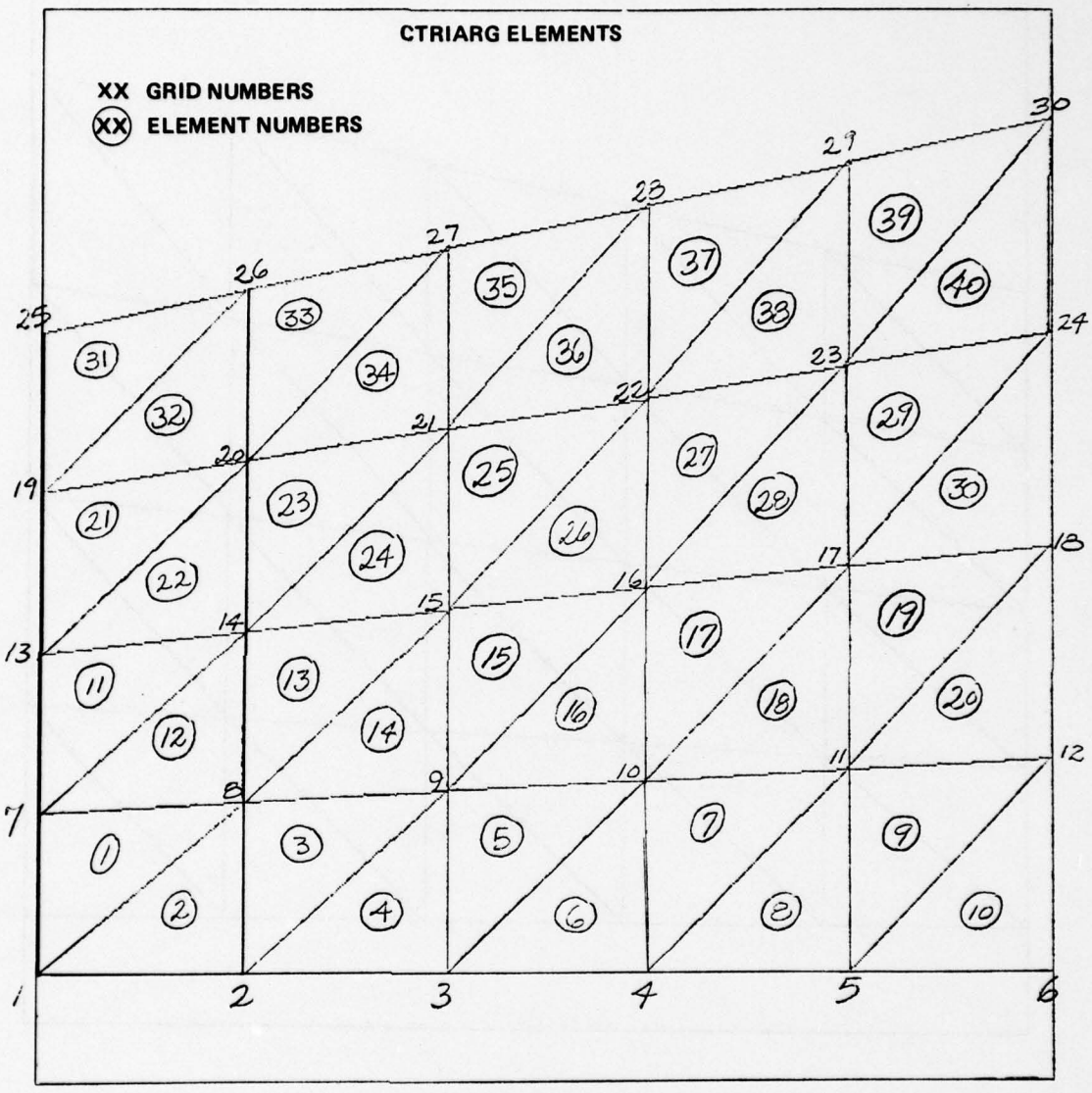


FIG. B-6 GRID POINT AND ELEMENT IDENTIFICATION NUMBERS

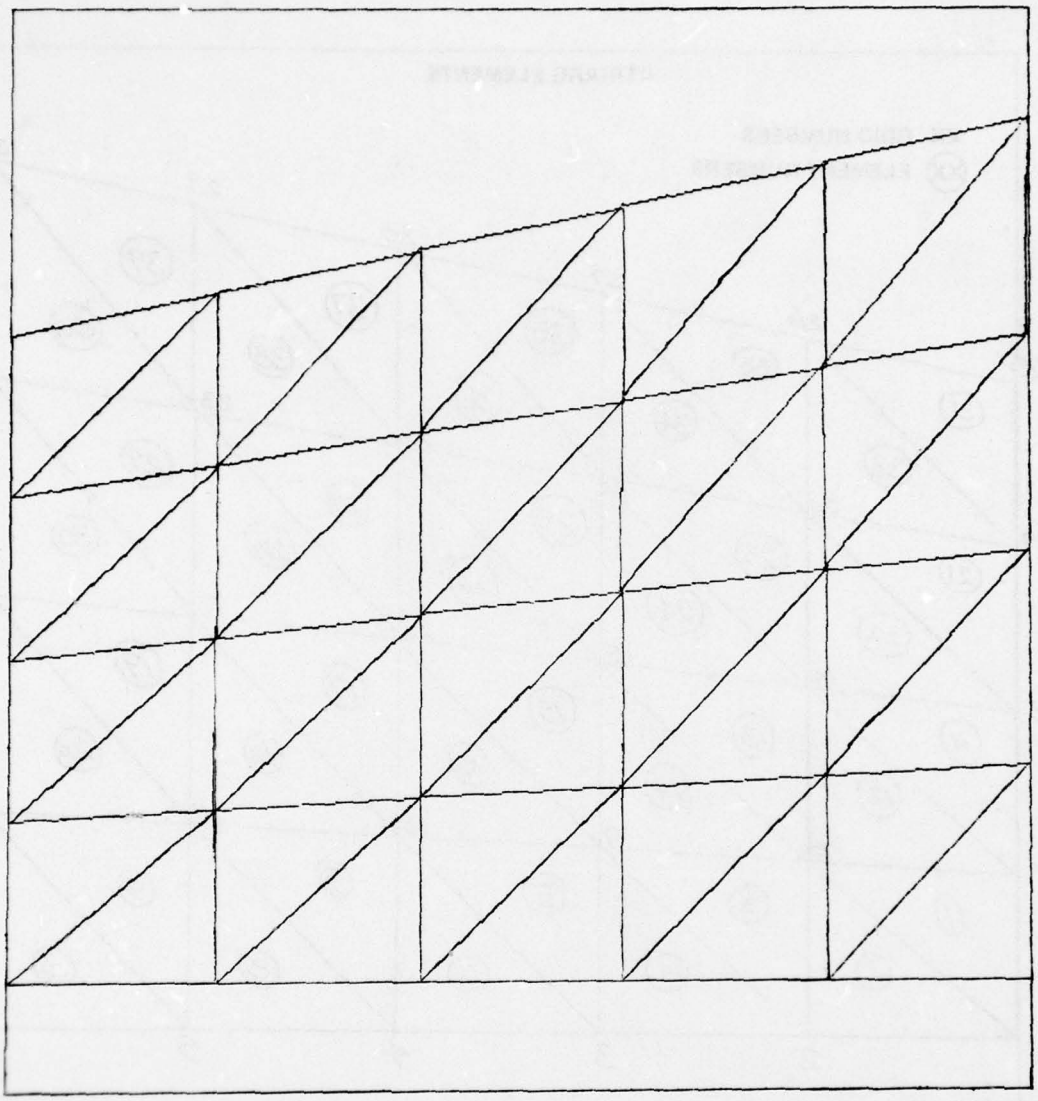


FIG. B-7 NASTRAN STRUCTURAL PLOT

LISTING OF PUNCHED NASTRAN BULK DATA CARDS
PROBLEM B-I-B AXISYMMETRIC RING ELEMENTS

```
**************************************************
**************************************************
**                                              **
**   JUNCTION INPUT GENERATOR PROGRAM   (JIG)   **
**                                              **
**************************************************
**************************************************
```

*** SAMPLE 1 - AXISYMMETRIC RING ELEMENTS ***

```
NST =      1
NGS =      1
NES =      1
NPOP =     1
MID =      5
NGP =      0
IDELT =    0
NSECT =    1
NT( 1) =     1     DELTZ( 1) =     0.0000
```

I	J	Z(I,J)	X(I,J)	CODE(I,J)
1	1	0.00000	1.00000	1
2	1	1.00000	1.00000	1
3	1	2.00000	1.00000	1
4	1	3.00000	1.00000	1
5	1	4.00000	1.00000	1
6	1	5.00000	1.00000	1
1	2	0.00000	1.75000	1
2	2	1.00000	1.79999	0
3	2	2.00001	1.85002	0
4	2	3.00002	1.90000	0
5	2	3.99999	1.94998	0
6	2	5.00000	2.00000	1
1	3	0.00000	2.50000	1
2	3	1.00003	2.60002	0
3	3	2.00002	2.70002	0
4	3	3.00000	2.79999	0
5	3	4.00000	2.90000	0
6	3	5.00000	3.00000	1
1	4	0.00000	3.25000	1
2	4	1.00002	3.40002	0
3	4	1.99998	3.54999	0
4	4	3.00000	3.70000	0
5	4	4.00000	3.84999	0
6	4	5.00000	4.00000	1
1	5	0.00000	4.00000	1
2	5	1.00000	4.20000	1
3	5	2.00000	4.40000	1
4	5	3.00000	4.60000	1
5	5	4.00000	4.80000	1
6	5	5.00000	5.00000	1

```
GRID            1       0  1.0000   0.0000   0.0000        0      456
GRID            2       0  1.0000   0.0000   1.0000        0      456
GRID            3       0  1.0000   0.0000   2.0000        0      456
GRID            4       0  1.0000   0.0000   3.0000        0      456
GRID            5       0  1.0000   0.0000   4.0000        0      456
GRID            6       0  1.0000   0.0000   5.0000        0      456
GRID            7       0  1.7500   0.0000   0.0000        0      456
GRID            8       0  1.8000   0.0000   1.0000        0      456
CTRIARG         1       8        7        1  0.0000        5
CTRIARG         2       1        2        8  0.0000        5
GRID            9       0  1.8500   0.0000   2.0000        0      456
CTRIARG         3       9        8        2  0.0000        5
CTRIARG         4       2        3        9  0.0000        5
GRID           10       0  1.9000   0.0000   3.0000        0      456
CTRIARG         5      10        9        3  0.0000        5
CTRIARG         6       3        4       10  0.0000        5
GRID           11       0  1.9500   0.0000   4.0000        0      456
CTRIARG         7      11       10        4  0.0000        5
CTRIARG         8       4        5       11  0.0000        5
GRID           12       0  2.0000   0.0000   5.0000        0      456
CTRIARG         9      12       11        5  0.0000        5
CTRIARG        10       5        6       12  0.0000        5
GRID           13       0  2.5000   0.0000   0.0000        0      456
GRID           14       0  2.6000   0.0000   1.0000        0      456
CTRIARG        11      14       13        7  0.0000        5
CTRIARG        12       7        8       14  0.0000        5
GRID           15       0  2.7000   0.0000   2.0000        0      456
CTRIARG        13      15       14        8  0.0000        5
```

CTRIARG	14	8	9	15	0.0000	5	
GRID	16	0	2.8000	0.0000	3.0000	0	456
CTRIARG	15	16	15	9	0.0000	5	
CTRIARG	16	9	10	16	0.0000	5	
GRID	17	0	2.9000	0.0000	4.0000	0	456
CTRIARG	17	17	16	10	0.0000	5	
CTRIARG	18	10	11	17	0.0000	5	
GRID	18	0	3.0000	0.0000	5.0000	0	456
CTRIARG	19	18	17	11	0.0000	5	
CTRIARG	20	11	12	18	0.0000	5	
GRID	19	0	3.2500	0.0000	0.0000	0	456
GRID	20	0	3.4000	0.0000	1.0000	0	456
CTRIARG	21	20	19	13	0.0000	5	
CTRIARG	22	13	14	20	0.0000	5	
GRID	21	0	3.5500	0.0000	2.0000	0	456
CTRIARG	23	21	20	14	0.0000	5	
CTRIARG	24	14	15	21	0.0000	5	
GRID	22	0	3.7000	0.0000	3.0000	0	456
CTRIARG	25	22	21	15	0.0000	5	
CTRIARG	26	15	16	22	0.0000	5	
GRID	23	0	3.8500	0.0000	4.0000	0	456
CTRIARG	27	23	22	16	0.0000	5	
CTRIARG	28	16	17	23	0.0000	5	
GRID	24	0	4.0000	0.0000	5.0000	0	456
CTRIARG	29	24	23	17	0.0000	5	
CTRIARG	30	17	18	24	0.0000	5	
GRID	25	0	4.0000	0.0000	0.0000	0	456
GRID	26	0	4.2000	0.0000	1.0000	0	456
CTRIARG	31	26	25	19	0.0000	5	
CTRIARG	32	19	20	26	0.0000	5	
GRID	27	0	4.4000	0.0000	2.0000	0	456
CTRIARG	33	27	26	20	0.0000	5	
CTRIARG	34	20	21	27	0.0000	5	
GRID	28	0	4.6000	0.0000	3.0000	0	456
CTRIARG	35	28	27	21	0.0000	5	
CTRIARG	36	21	22	28	0.0000	5	
GRID	29	0	4.8000	0.0000	4.0000	0	456
CTRIARG	37	29	28	22	0.0000	5	
CTRIARG	38	22	23	29	0.0000	5	
GRID	30	0	5.0000	0.0000	5.0000	0	456
CTRIARG	39	30	29	23	0.0000	5	
CTRIARG	40	23	24	30	0.0000	5	

```
*** SAMPLE 1 - 3D SOLID ELEMENTS ***
   1     1     1     3     5     0     1     1
   1
  0.0
   1     1   100
   1     0.0         7 180.0
  0.0       180.0
   1     5
   4     1     5     1     6     0     0     0     0     0 456     0
   1     1   0.0         1.0           1     6     1     5.0         1.0          1
   6     5   5.0         5.0           1     1     5     0.0         4.0          1
```

FIG. B-8 DATA INPUT PROBLEM B-I-C

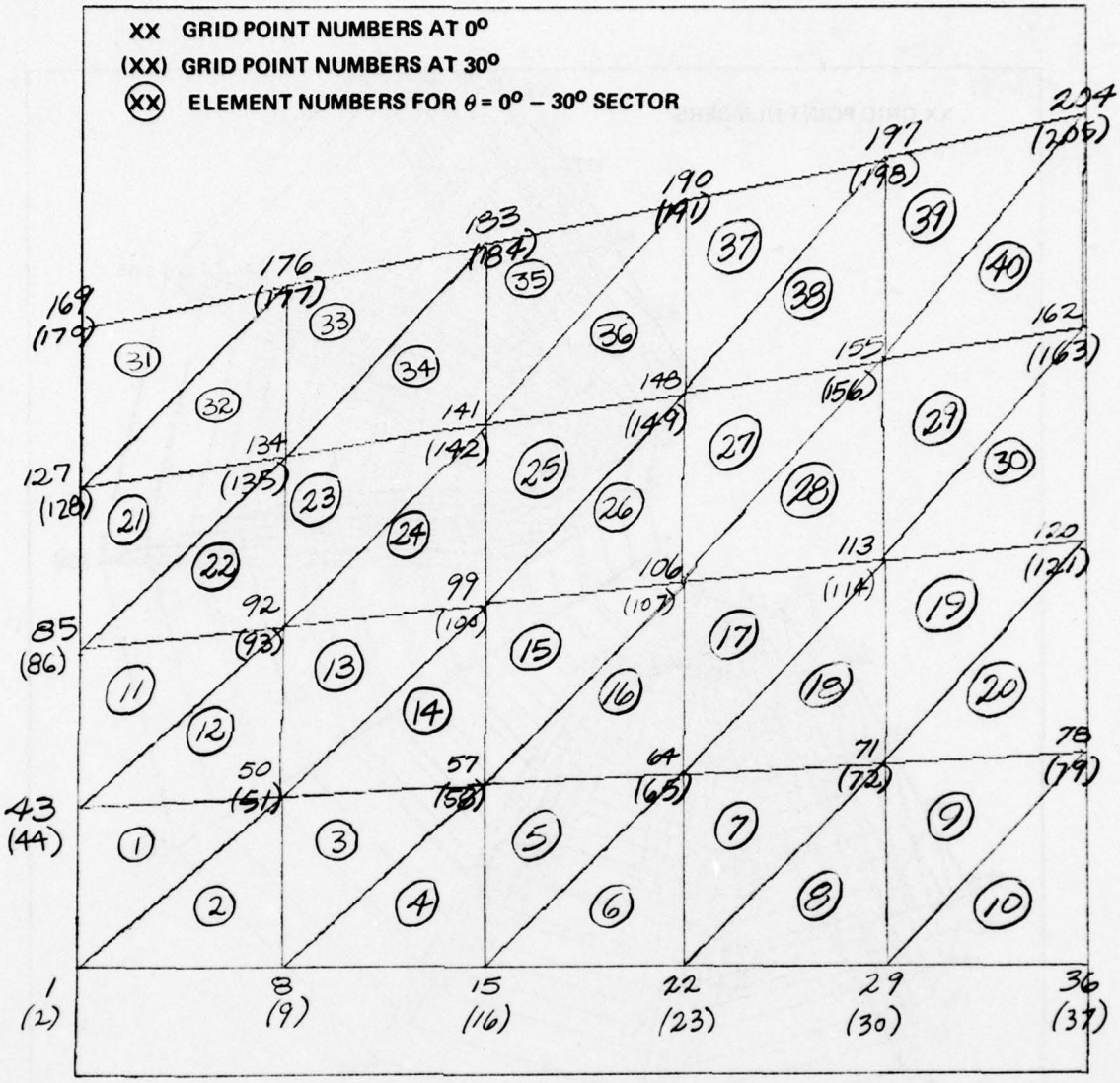


FIG. B-9 GRID POINT AND ELEMENT NUMBERS

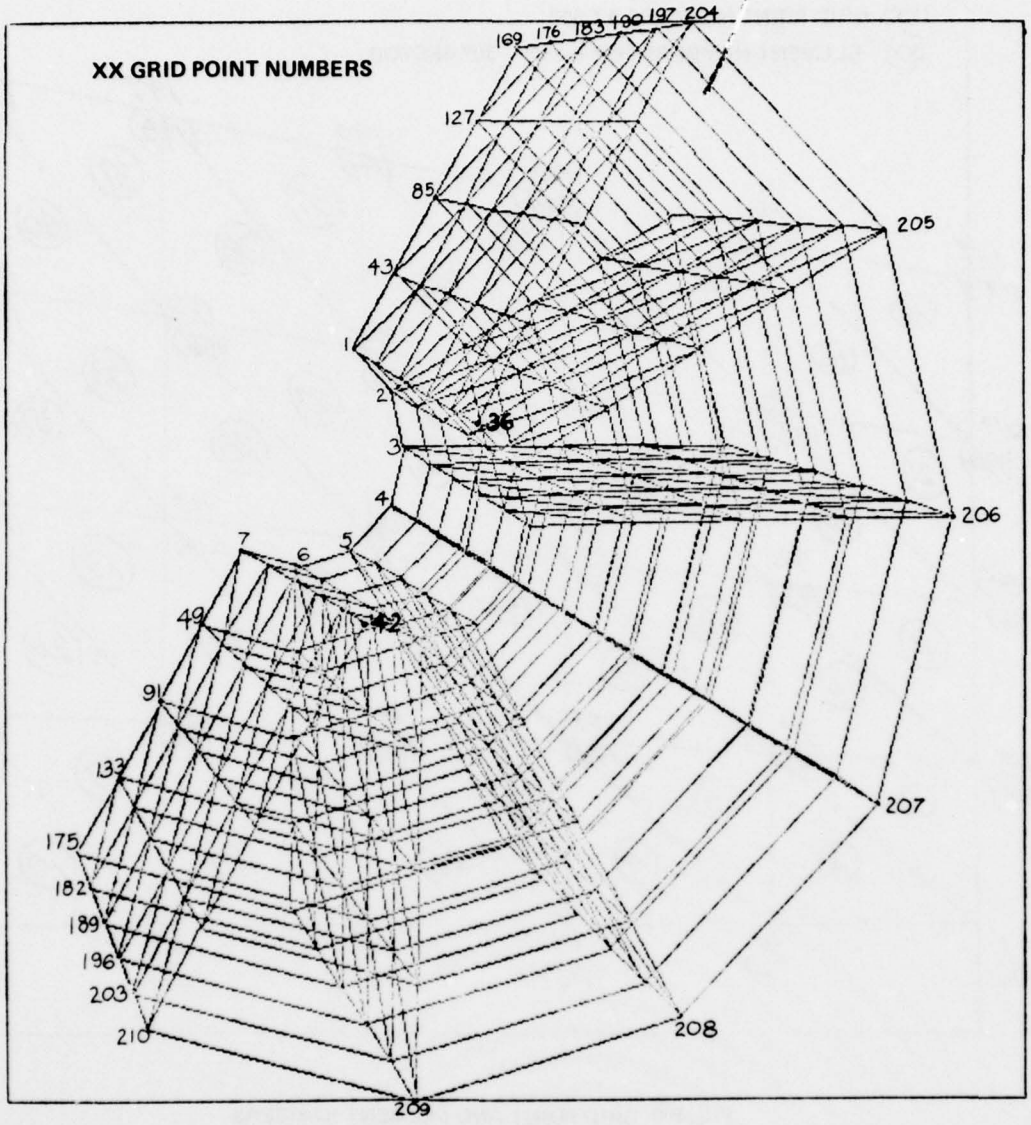


FIG. B-10 GRID POINT NUMBERS

the grid point and element identification numbers as generated by JIG. Figure B-11 gives the structural plot of the finite element model followed by a listing of the JIG punched output.

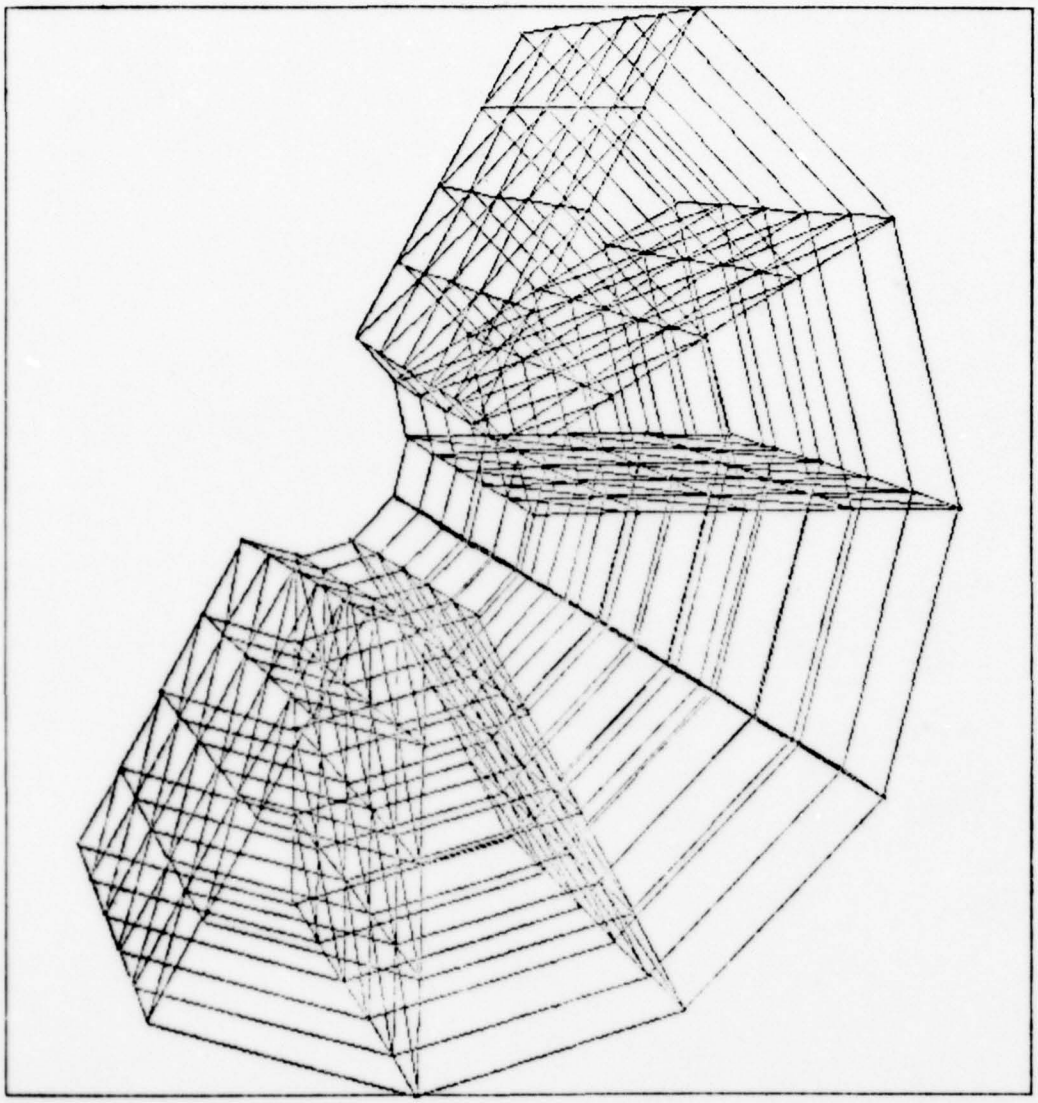


FIG. B-11 NASTRAN STRUCTURAL PLOT

LISTING OF PUNCHED NASTRAN BULK DATA CARDS
PROBLEM B-I-C 3-D SOLID ELEMENTS

```
**********************************************
**********************************************
**                                          **
**   JUNCTION INPUT GENERATOR PROGRAM  (JIG)  **
**                                          **
**********************************************
**********************************************
```

*** SAMPLE 1 - 30 SOLID ELEMENTS ***

```
NST =      1
NGS =      1
NES =      1
NPOP =     3
MIJ =      5
NGP =      0
IDELT =    1
NSECT =    1
NT( 1) =     1     DELTZ( 1) =     0.0000
NDT =      1
ICLOSE =   1
DELGP =  100
KK( 1) =     1     THETA( 1) =     0.0000
KK( 2) =     7     THETA( 2) =   180.0000
BETA( 1) =     0.0000
BETA( 2) =   180.0000
JB( 1) =     1     JE( 1) =     5
```

I	J	Z(I,J)	X(I,J)	CODE(I,J)
1	1	0.00000	1.00000	1
2	1	1.00000	1.00000	1
3	1	2.00000	1.00000	1
4	1	3.00000	1.00000	1
5	1	4.00000	1.00000	1
6	1	5.00000	1.00000	1
1	2	0.00000	1.75000	1
2	2	1.00000	1.79999	0
3	2	2.00001	1.85002	0
4	2	3.00002	1.90000	0
5	2	3.99999	1.94998	0
6	2	5.00000	2.00000	1
1	3	0.00000	2.50000	1
2	3	1.00003	2.60002	0
3	3	2.00002	2.70002	0
4	3	3.00000	2.79999	0
5	3	4.00000	2.90000	0
6	3	5.00000	3.00000	1
1	4	0.00000	3.25000	1
2	4	1.00002	3.40002	0
3	4	1.99998	3.54999	0
4	4	3.00000	3.70000	0
5	4	4.00000	3.84999	0
6	4	5.00000	4.00000	1
1	5	0.00000	4.00000	1
2	5	1.00000	4.20000	1
3	5	2.00000	4.40000	1
4	5	3.00000	4.60000	1
5	5	4.00000	4.80000	1
6	5	5.00000	5.00000	1

GRID		1	1	1.0000	0.0000	0.0000	1	456
GRID		2	1	1.0000	30.0000	0.0000	1	456
GRID		3	1	1.0000	60.0000	0.0000	1	456
GRID		4	1	1.0000	90.0000	0.0000	1	456
GRID		5	1	1.0000	120.0000	0.0000	1	456
GRID		6	1	1.0000	150.0000	0.0000	1	456
GRID		7	1	1.0000	180.0000	0.0000	1	456
GRID		8	1	1.0000	0.0000	1.0000	1	456
GRID		9	1	1.0000	30.0000	1.0000	1	456
GRID		10	1	1.0000	60.0000	1.0000	1	456
GRID		11	1	1.0000	90.0000	1.0000	1	456
GRID		12	1	1.0000	120.0000	1.0000	1	456
GRID		13	1	1.0000	150.0000	1.0000	1	456
GRID		14	1	1.0000	180.0000	1.0000	1	456
GRID		15	1	1.0000	0.0000	2.0000	1	456
GRID		16	1	1.0000	30.0000	2.0000	1	456
GRID		17	1	1.0000	60.0000	2.0000	1	456
GRID		18	1	1.0000	90.0000	2.0000	1	456
GRID		19	1	1.0000	120.0000	2.0000	1	456
GRID		20	1	1.0000	150.0000	2.0000	1	456
GRID		21	1	1.0000	180.0000	2.0000	1	456
GRID		22	1	1.0000	0.0000	3.0000	1	456
GRID		23	1	1.0000	30.0000	3.0000	1	456
GRID		24	1	1.0000	60.0000	3.0000	1	456
GRID		25	1	1.0000	90.0000	3.0000	1	456
GRID		26	1	1.0000	120.0000	3.0000	1	456
GRID		27	1	1.0000	150.0000	3.0000	1	456
GRID		28	1	1.0000	180.0000	3.0000	1	456

```
GRID      29      1  1.0000   0.0000  4.0000      1     456
GRID      30      1  1.0000  30.0000  4.0000      1     456
GRID      31      1  1.0000  60.0000  4.0000      1     456
GRID      32      1  1.0000  90.0000  4.0000      1     456
GRID      33      1  1.0000 120.0000  4.0000      1     456
GRID      34      1  1.0000 150.0000  4.0000      1     456
GRID      35      1  1.0000 180.0000  4.0000      1     456
GRID      36      1  1.0000   0.0000  5.0000      1     456
GRID      37      1  1.0000  30.0000  5.0000      1     456
GRID      38      1  1.0000  60.0000  5.0000      1     456
GRID      39      1  1.0000  90.0000  5.0000      1     456
GRID      40      1  1.0000 120.0000  5.0000      1     456
GRID      41      1  1.0000 150.0000  5.0000      1     456
GRID      42      1  1.0000 180.0000  5.0000      1     456
GRID      43      1  1.7500   0.0000  0.0000      1     456
GRID      44      1  1.7500  30.0000  0.0000      1     456
GRID      45      1  1.7500  60.0000  0.0000      1     456
GRID      46      1  1.7500  90.0000  0.0000      1     456
GRID      47      1  1.7500 120.0000  0.0000      1     456
GRID      48      1  1.7500 150.0000  0.0000      1     456
GRID      49      1  1.7500 180.0000  0.0000      1     456
GRID      50      1  1.8000   0.0000  1.0000      1     456
GRID      51      1  1.8000  30.0000  1.0000      1     456
GRID      52      1  1.8000  60.0000  1.0000      1     456
GRID      53      1  1.8000  90.0000  1.0000      1     456
GRID      54      1  1.8000 120.0000  1.0000      1     456
GRID      55      1  1.8000 150.0000  1.0000      1     456
GRID      56      1  1.8000 180.0000  1.0000      1     456
CWEDGE     1      5      50      43       1     51      44       2
CWEDGE   101      5      51      44       2     52      45       3
CWEDGE   201      5      52      45       3     53      46       4
CWEDGE   301      5      53      46       4     54      47       5
CWEDGE   401      5      54      47       5     55      48       6
CWEDGE   501      5      55      48       6     56      49       7
CWEDGE     2      5       1       8      50      2       9      51
CWEDGE   102      5       2       9      51      3      10      52
CWEDGE   202      5       3      10      52      4      11      53
CWEDGE   302      5       4      11      53      5      12      54
CWEDGE   402      5       5      12      54      6      13      55
CWEDGE   502      5       6      13      55      7      14      56
GRID      57      1  1.8500   0.0000  2.0000      1     456
GRID      58      1  1.8500  30.0000  2.0000      1     456
GRID      59      1  1.8500  60.0000  2.0000      1     456
GRID      60      1  1.8500  90.0000  2.0000      1     456
GRID      61      1  1.8500 120.0000  2.0000      1     456
GRID      62      1  1.8500 150.0000  2.0000      1     456
GRID      63      1  1.8500 180.0000  2.0000      1     456
CWEDGE     3      5      57      50       8     58      51       9
CWEDGE   103      5      58      51       9     59      52      10
CWEDGE   203      5      59      52      10     60      53      11
CWEDGE   303      5      60      53      11     61      54      12
CWEDGE   403      5      61      54      12     62      55      13
CWEDGE   503      5      62      55      13     63      56      14
CWEDGE     4      5       8      15      57      9      16      58
CWEDGE   104      5       9      16      58     10      17      59
CWEDGE   204      5      10      17      59     11      18      60
CWEDGE   304      5      11      18      60     12      19      61
CWEDGE   404      5      12      19      61     13      20      62
CWEDGE   504      5      13      20      62     14      21      63
GRID      64      1  1.9000   0.0000  3.0000      1     456
GRID      65      1  1.9000  30.0000  3.0000      1     456
GRID      66      1  1.9000  60.0000  3.0000      1     456
GRID      67      1  1.9000  90.0000  3.0000      1     456
GRID      68      1  1.9000 120.0000  3.0000      1     456
```

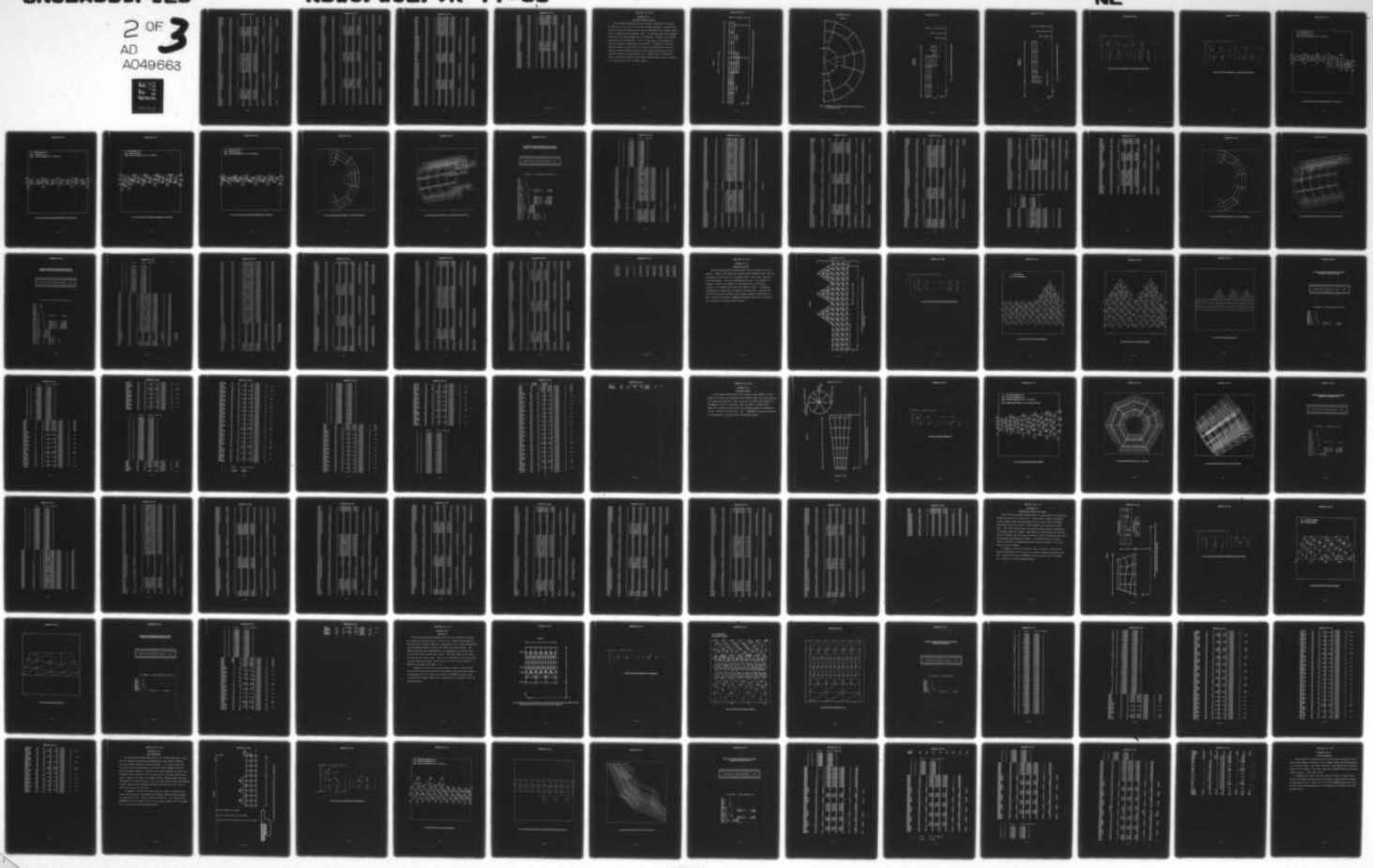
```
GRID      69      1  1.9000150.0000  3.0000      1     456
GRID      70      1  1.9000180.0000  3.0000      1     456
CWEDGE     5      5      64      57      15      65      58      16
CWEDGE   105      5      65      58      16      66      59      17
CWEDGE   205      5      66      59      17      67      60      18
CWEDGE   305      5      67      60      18      68      61      19
CWEDGE   405      5      68      61      19      69      62      20
CWEDGE   505      5      69      62      20      70      63      21
CWEDGE     6      5      15      22      64      16      23      65
CWEDGE   106      5      16      23      65      17      24      66
CWEDGE   206      5      17      24      66      18      25      67
CWEDGE   306      5      18      25      67      19      26      68
CWEDGE   406      5      19      26      68      20      27      69
CWEDGE   506      5      20      27      69      21      28      70
GRID      71      1  1.9500   0.0000  4.0000      1     456
GRID      72      1  1.9500  30.0000  4.0000      1     456
GRID      73      1  1.9500  60.0000  4.0000      1     456
GRID      74      1  1.9500  90.0000  4.0000      1     456
GRID      75      1  1.9500120.0000  4.0000      1     456
GRID      76      1  1.9500150.0000  4.0000      1     456
GRID      77      1  1.9500180.0000  4.0000      1     456
CWEDGE     7      5      71      64      22      72      65      23
CWEDGE   107      5      72      65      23      73      66      24
CWEDGE   207      5      73      66      24      74      67      25
CWEDGE   307      5      74      67      25      75      68      26
CWEDGE   407      5      75      68      26      76      69      27
CWEDGE   507      5      76      69      27      77      70      28
CWEDGE     8      5      22      29      71      23      30      72
CWEDGE   108      5      23      30      72      24      31      73
CWEDGE   208      5      24      31      73      25      32      74
CWEDGE   308      5      25      32      74      26      33      75
CWEDGE   408      5      26      33      75      27      34      76
CWEDGE   508      5      27      34      76      28      35      77
GRID      78      1  2.0000   0.0000  5.0000      1     456
GRID      79      1  2.0000  30.0000  5.0000      1     456
GRID      80      1  2.0000  60.0000  5.0000      1     456
GRID      81      1  2.0000  90.0000  5.0000      1     456
GRID      82      1  2.0000120.0000  5.0000      1     456
GRID      83      1  2.0000150.0000  5.0000      1     456
GRID      84      1  2.0000180.0000  5.0000      1     456
CWEDGE     9      5      78      71      29      79      72      30
CWEDGE   109      5      79      72      30      80      73      31
CWEDGE   209      5      80      73      31      81      74      32
CWEDGE   309      5      81      74      32      82      75      33
CWEDGE   409      5      82      75      33      83      76      34
CWEDGE   509      5      83      76      34      84      77      35
CWEDGE    10      5      29      36      78      30      37      79
CWEDGE   110      5      30      37      79      31      38      80
CWEDGE   210      5      31      38      80      32      39      81
CWEDGE   310      5      32      39      81      33      40      82
CWEDGE   410      5      33      40      82      34      41      83
CWEDGE   510      5      34      41      83      35      42      84
GRID      85      1  2.5000   0.0000  0.0000      1     456
GRID      86      1  2.5000  30.0000  0.0000      1     456
GRID      87      1  2.5000  60.0000  0.0000      1     456
GRID      88      1  2.5000  90.0000  0.0000      1     456
GRID      89      1  2.5000120.0000  0.0000      1     456
GRID      90      1  2.5000150.0000  0.0000      1     456
GRID      91      1  2.5000180.0000  0.0000      1     456
GRID      92      1  2.6000   0.0000  1.0000      1     456
GRID      93      1  2.6000  30.0000  1.0000      1     456
GRID      94      1  2.6000  60.0000  1.0000      1     456
GRID      95      1  2.6000  90.0000  1.0000      1     456
GRID      96      1  2.6000120.0000  1.0000      1     456
```

```
GRID      97     1  2.6000150.0000  1.0000     1   456
GRID      98     1  2.6000180.0000  1.0000     1   456
CWEDGE    11     5      92      85      43      93      86      44
CWEDGE   111     5      93      86      44      94      87      45
CWEDGE   211     5      94      87      45      95      88      46
CWEDGE   311     5      95      88      46      96      89      47
CWEDGE   411     5      96      89      47      97      90      48
CWEDGE   511     5      97      90      48      98      91      49
CWEDGE    12     5      43      50      92      44      51      93
CWEDGE   112     5      44      51      93      45      52      94
CWEDGE   212     5      45      52      94      46      53      95
CWEDGE   312     5      46      53      95      47      54      96
CWEDGE   412     5      47      54      96      48      55      97
CWEDGE   512     5      48      55      97      49      56      98
GRID      99     1  2.7000   0.0000  2.0000     1   456
GRID     100     1  2.7000  30.0000  2.0000     1   456
GRID     101     1  2.7000  60.0000  2.0000     1   456
GRID     102     1  2.7000  90.0000  2.0000     1   456
GRID     103     1  2.7000120.0000  2.0000     1   456
GRID     104     1  2.7000150.0000  2.0000     1   456
GRID     105     1  2.7000180.0000  2.0000     1   456
CWEDGE    13     5      99      92      50     100      93      51
CWEDGE   113     5     100      93      51     101      94      52
CWEDGE   213     5     101      94      52     102      95      53
CWEDGE   313     5     102      95      53     103      96      54
CWEDGE   413     5     103      96      54     104      97      55
CWEDGE   513     5     104      97      55     105      98      56
CWEDGE    14     5      50      57      99      51      58     100
CWEDGE   114     5      51      58     100      52      59     101
CWEDGE   214     5      52      59     101      53      60     102
CWEDGE   314     5      53      60     102      54      61     103
CWEDGE   414     5      54      61     103      55      62     104
CWEDGE   514     5      55      62     104      56      63     105
GRID     106     1  2.8000   0.0000  3.0000     1   456
GRID     107     1  2.8000  30.0000  3.0000     1   456
GRID     108     1  2.8000  60.0000  3.0000     1   456
GRID     109     1  2.8000  90.0000  3.0000     1   456
GRID     110     1  2.8000120.0000  3.0000     1   456
GRID     111     1  2.8000150.0000  3.0000     1   456
GRID     112     1  2.8000180.0000  3.0000     1   456
CWEDGE    15     5     106      99      57     107     100      58
CWEDGE   115     5     107     100      58     108     101      59
CWEDGE   215     5     108     101      59     109     102      60
CWEDGE   315     5     109     102      60     110     103      61
CWEDGE   415     5     110     103      61     111     104      62
CWEDGE   515     5     111     104      62     112     105      63
CWEDGE    16     5      57      64     106      58      65     107
CWEDGE   116     5      58      65     107      59      66     108
CWEDGE   216     5      59      66     108      60      67     109
CWEDGE   316     5      60      67     109      61      68     110
CWEDGE   416     5      61      68     110      62      69     111
CWEDGE   516     5      62      69     111      63      70     112
GRID     113     1  2.9000   0.0000  4.0000     1   456
GRID     114     1  2.9000  30.0000  4.0000     1   456
GRID     115     1  2.9000  60.0000  4.0000     1   456
GRID     116     1  2.9000  90.0000  4.0000     1   456
GRID     117     1  2.9000120.0000  4.0000     1   456
GRID     118     1  2.9000150.0000  4.0000     1   456
GRID     119     1  2.9000180.0000  4.0000     1   456
CWEDGE    17     5     113     106      64     114     107      65
CWEDGE   117     5     114     107      65     115     108      66
CWEDGE   217     5     115     108      66     116     109      67
CWEDGE   317     5     116     109      67     117     110      68
CWEDGE   417     5     117     110      68     118     111      69
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AD-A049 663 NAVAL SURFACE WEAPONS CENTER WHITE OAK LAB SILVER SP--ETC F/G 13/13
JUNCTION INPUT GENERATOR (JIG), A NASTRAN PRE-PROCESSOR: THEORE--ETC(U)
SEP 77 P C HUANG, K C KIDDY, J P MATRA

UNCLASSIFIED NSWC/WOL/TR-77-85 NL

2 OF 3
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CWEDGE    517     5     118     111      69     119     112      70
CWEDGE     18     5      64      71     113      65      72     114
CWEDGE    118     5      65      72     114      66      73     115
CWEDGE    218     5      66      73     115      67      74     116
CWEDGE    318     5      67      74     116      68      75     117
CWEDGE    418     5      68      75     117      69      76     118
CWEDGE    518     5      69      76     118      70      77     119
GRID      120     1  3.0000   0.0000  5.0000       1     456
GRID      121     1  3.0000  30.0000  5.0000       1     456
GRID      122     1  3.0000  60.0000  5.0000       1     456
GRID      123     1  3.0000  90.0000  5.0000       1     456
GRID      124     1  3.0000 120.0000  5.0000       1     456
GRID      125     1  3.0000 150.0000  5.0000       1     456
GRID      126     1  3.0000 180.0000  5.0000       1     456
CWEDGE     19     5     120     113      71     121     114      72
CWEDGE    119     5     121     114      72     122     115      73
CWEDGE    219     5     122     115      73     123     116      74
CWEDGE    319     5     123     116      74     124     117      75
CWEDGE    419     5     124     117      75     125     118      76
CWEDGE    519     5     125     118      76     126     119      77
CWEDGE     20     5      71      78     120      72      79     121
CWEDGE    120     5      72      79     121      73      80     122
CWEDGE    220     5      73      80     122      74      81     123
CWEDGE    320     5      74      81     123      75      82     124
CWEDGE    420     5      75      82     124      76      83     125
CWEDGE    520     5      76      83     125      77      84     126
GRID      127     1  3.2500   0.0000  0.0000       1     456
GRID      128     1  3.2500  30.0000  0.0000       1     456
GRID      129     1  3.2500  60.0000  0.0000       1     456
GRID      130     1  3.2500  90.0000  0.0000       1     456
GRID      131     1  3.2500 120.0000  0.0000       1     456
GRID      132     1  3.2500 150.0000  0.0000       1     456
GRID      133     1  3.2500 180.0000  0.0000       1     456
GRID      134     1  3.4000   0.0000  1.0000       1     456
GRID      135     1  3.4000  30.0000  1.0000       1     456
GRID      136     1  3.4000  60.0000  1.0000       1     456
GRID      137     1  3.4000  90.0000  1.0000       1     456
GRID      138     1  3.4000 120.0000  1.0000       1     456
GRID      139     1  3.4000 150.0000  1.0000       1     456
GRID      140     1  3.4000 180.0000  1.0000       1     456
CWEDGE     21     5     134     127      85     135     128      86
CWEDGE    121     5     135     128      86     136     129      87
CWEDGE    221     5     136     129      87     137     130      88
CWEDGE    321     5     137     130      88     138     131      89
CWEDGE    421     5     138     131      89     139     132      90
CWEDGE    521     5     139     132      90     140     133      91
CWEDGE     22     5      85      92     134      86      93     135
CWEDGE    122     5      86      93     135      87      94     136
CWEDGE    222     5      87      94     136      88      95     137
CWEDGE    322     5      88      95     137      89      96     138
CWEDGE    422     5      89      96     138      90      97     139
CWEDGE    522     5      90      97     139      91      98     140
GRID      141     1  3.5500   0.0000  2.0000       1     456
GRID      142     1  3.5500  30.0000  2.0000       1     456
GRID      143     1  3.5500  60.0000  2.0000       1     456
GRID      144     1  3.5500  90.0000  2.0000       1     456
GRID      145     1  3.5500 120.0000  2.0000       1     456
GRID      146     1  3.5500 150.0000  2.0000       1     456
GRID      147     1  3.5500 180.0000  2.0000       1     456
CWEDGE     23     5     141     134      92     142     135      93
CWEDGE    123     5     142     135      93     143     136      94
CWEDGE    223     5     143     136      94     144     137      95
CWEDGE    323     5     144     137      95     145     138      96
CWEDGE    423     5     145     138      96     146     139      97
```

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CWEDGE    523       5     146     139      97     147     140      98
CWEDGE     24       5      92      99     141      93     100     142
CWEDGE    124       5      93     100     142      94     101     143
CWEDGE    224       5      94     101     143      95     102     144
CWEDGE    324       5      95     102     144      96     103     145
CWEDGE    424       5      96     103     145      97     104     146
CWEDGE    524       5      97     104     146      98     105     147
GRID      148       1  3.7000   0.0000  3.0000       1     456
GRID      149       1  3.7000  30.0000  3.0000       1     456
GRID      150       1  3.7000  60.0000  3.0000       1     456
GRID      151       1  3.7000  90.0000  3.0000       1     456
GRID      152       1  3.7000 120.0000  3.0000       1     456
GRID      153       1  3.7000 150.0000  3.0000       1     456
GRID      154       1  3.7000 180.0000  3.0000       1     456
CWEDGE     25       5     148     141      99     149     142     100
CWEDGE    125       5     149     142     100     150     143     101
CWEDGE    225       5     150     143     101     151     144     102
CWEDGE    325       5     151     144     102     152     145     103
CWEDGE    425       5     152     145     103     153     146     104
CWEDGE    525       5     153     146     104     154     147     105
CWEDGE     26       5      99     106     148     100     107     149
CWEDGE    126       5     100     107     149     101     108     150
CWEDGE    226       5     101     108     150     102     109     151
CWEDGE    326       5     102     109     151     103     110     152
CWEDGE    426       5     103     110     152     104     111     153
CWEDGE    526       5     104     111     153     105     112     154
GRID      155       1  3.8500   0.0000  4.0000       1     456
GRID      156       1  3.8500  30.0000  4.0000       1     456
GRID      157       1  3.8500  60.0000  4.0000       1     456
GRID      158       1  3.8500  90.0000  4.0000       1     456
GRID      159       1  3.8500 120.0000  4.0000       1     456
GRID      160       1  3.8500 150.0000  4.0000       1     456
GRID      161       1  3.8500 180.0000  4.0000       1     456
CWEDGE     27       5     155     148     106     156     149     107
CWEDGE    127       5     156     149     107     157     150     108
CWEDGE    227       5     157     150     108     158     151     109
CWEDGE    327       5     158     151     109     159     152     110
CWEDGE    427       5     159     152     110     160     153     111
CWEDGE    527       5     160     153     111     161     154     112
CWEDGE     28       5     106     113     155     107     114     156
CWEDGE    128       5     107     114     156     108     115     157
CWEDGE    228       5     108     115     157     109     116     158
CWEDGE    328       5     109     116     158     110     117     159
CWEDGE    428       5     110     117     159     111     118     160
CWEDGE    528       5     111     118     160     112     119     161
GRID      162       1  4.0000   0.0000  5.0000       1     456
GRID      163       1  4.0000  30.0000  5.0000       1     456
GRID      164       1  4.0000  60.0000  5.0000       1     456
GRID      165       1  4.0000  90.0000  5.0000       1     456
GRID      166       1  4.0000 120.0000  5.0000       1     456
GRID      167       1  4.0000 150.0000  5.0000       1     456
GRID      168       1  4.0000 180.0000  5.0000       1     456
CWEDGE     29       5     162     155     113     163     156     114
CWEDGE    129       5     163     156     114     164     157     115
CWEDGE    229       5     164     157     115     165     158     116
CWEDGE    329       5     165     158     116     166     159     117
CWEDGE    429       5     166     159     117     167     160     118
CWEDGE    529       5     167     160     118     168     161     119
CWEDGE     30       5     113     120     162     114     121     163
CWEDGE    130       5     114     121     163     115     122     164
CWEDGE    230       5     115     122     164     116     123     165
CWEDGE    330       5     116     123     165     117     124     166
CWEDGE    430       5     117     124     166     118     125     167
CWEDGE    530       5     118     125     167     119     126     168
```

```
GRID      169     1  4.0000   0.0000   0.0000       1     456
GRID      170     1  4.0000  30.0000   0.0000       1     456
GRID      171     1  4.0000  60.0000   0.0000       1     456
GRID      172     1  4.0000  90.0000   0.0000       1     456
GRID      173     1  4.0000 120.0000   0.0000       1     456
GRID      174     1  4.0000 150.0000   0.0000       1     456
GRID      175     1  4.0000 180.0000   0.0000       1     456
GRID      176     1  4.2000   0.0000   1.0000       1     456
GRID      177     1  4.2000  30.0000   1.0000       1     456
GRID      178     1  4.2000  60.0000   1.0000       1     456
GRID      179     1  4.2000  90.0000   1.0000       1     456
GRID      180     1  4.2000 120.0000   1.0000       1     456
GRID      181     1  4.2000 150.0000   1.0000       1     456
GRID      182     1  4.2000 180.0000   1.0000       1     456
CWEDGE     31     5     176      169      127      177     170      128
CWEDGE    131     5     177      170      128      178     171      129
CWEDGE    231     5     178      171      129      179     172      130
CWEDGE    331     5     179      172      130      180     173      131
CWEDGE    431     5     180      173      131      181     174      132
CWEDGE    531     5     181      174      132      182     175      133
CWEDGE     32     5     127      134      176      128     135      177
CWEDGE    132     5     128      135      177      129     136      178
CWEDGE    232     5     129      136      178      130     137      179
CWEDGE    332     5     130      137      179      131     138      180
CWEDGE    432     5     131      138      180      132     139      181
CWEDGE    532     5     132      139      181      133     140      182
GRID      183     1  4.4000   0.0000   2.0000       1     456
GRID      184     1  4.4000  30.0000   2.0000       1     456
GRID      185     1  4.4000  60.0000   2.0000       1     456
GRID      186     1  4.4000  90.0000   2.0000       1     456
GRID      187     1  4.4000 120.0000   2.0000       1     456
GRID      188     1  4.4000 150.0000   2.0000       1     456
GRID      189     1  4.4000 180.0000   2.0000       1     456
CWEDGE     33     5     183      176      134      184     177      135
CWEDGE    133     5     184      177      135      185     178      136
CWEDGE    233     5     185      178      136      186     179      137
CWEDGE    333     5     186      179      137      187     180      138
CWEDGE    433     5     187      180      138      188     181      139
CWEDGE    533     5     188      181      139      189     182      140
CWEDGE     34     5     134      141      183      135     142      184
CWEDGE    134     5     135      142      184      136     143      185
CWEDGE    234     5     136      143      185      137     144      186
CWEDGE    334     5     137      144      186      138     145      187
CWEDGE    434     5     138      145      187      139     146      188
CWEDGE    534     5     139      146      188      140     147      189
GRID      190     1  4.6000   0.0000   3.0000       1     456
GRID      191     1  4.6000  30.0000   3.0000       1     456
GRID      192     1  4.6000  60.0000   3.0000       1     456
GRID      193     1  4.6000  90.0000   3.0000       1     456
GRID      194     1  4.6000 120.0000   3.0000       1     456
GRID      195     1  4.6000 150.0000   3.0000       1     456
GRID      196     1  4.6000 180.0000   3.0000       1     456
CWEDGE     35     5     190      183      141      191     184      142
CWEDGE    135     5     191      184      142      192     185      143
CWEDGE    235     5     192      185      143      193     186      144
CWEDGE    335     5     193      186      144      194     187      145
CWEDGE    435     5     194      187      145      195     188      146
CWEDGE    535     5     195      188      146      196     189      147
CWEDGE     36     5     141      148      190      142     149      191
CWEDGE    136     5     142      149      191      143     150      192
CWEDGE    236     5     143      150      192      144     151      193
CWEDGE    336     5     144      151      193      145     152      194
CWEDGE    436     5     145      152      194      146     153      195
CWEDGE    536     5     146      153      195      147     154      196
```

```
GRID      197      1  4.8000   0.0000   4.0000       1      456
GRID      198      1  4.8000  30.0000   4.0000       1      456
GRID      199      1  4.8000  60.0000   4.0000       1      456
GRID      200      1  4.8000  90.0000   4.0000       1      456
GRID      201      1  4.8000 120.0000   4.0000       1      456
GRID      202      1  4.8000 150.0000   4.0000       1      456
GRID      203      1  4.8000 180.0000   4.0000       1      456
CWEDGE     37      5      197      190      148      198      191      149
CWEDGE    137      5      198      191      149      199      192      150
CWEDGE    237      5      199      192      150      200      193      151
CWEDGE    337      5      200      193      151      201      194      152
CWEDGE    437      5      201      194      152      202      195      153
CWEDGE    537      5      202      195      153      203      196      154
CWEDGE     38      5      148      155      197      149      156      198
CWEDGE    138      5      149      156      198      150      157      199
CWEDGE    238      5      150      157      199      151      158      200
CWEDGE    338      5      151      158      200      152      159      201
CWEDGE    438      5      152      159      201      153      160      202
CWEDGE    538      5      153      160      202      154      161      203
GRID      204      1  5.0000   0.0000   5.0000       1      456
GRID      205      1  5.0000  30.0000   5.0000       1      456
GRID      206      1  5.0000  60.0000   5.0000       1      456
GRID      207      1  5.0000  90.0000   5.0000       1      456
GRID      208      1  5.0000 120.0000   5.0000       1      456
GRID      209      1  5.0000 150.0000   5.0000       1      456
GRID      210      1  5.0000 180.0000   5.0000       1      456
CWEDGE     39      5      204      197      155      205      198      156
CWEDGE    139      5      205      198      156      206      199      157
CWEDGE    239      5      206      199      157      207      200      158
CWEDGE    339      5      207      200      158      208      201      159
CWEDGE    439      5      208      201      159      209      202      160
CWEDGE    539      5      209      202      160      210      203      161
CWEDGE     40      5      155      162      204      156      163      205
CWEDGE    140      5      156      163      205      157      164      206
CWEDGE    240      5      157      164      206      158      165      207
CWEDGE    340      5      158      165      207      159      166      208
CWEDGE    440      5      159      166      208      160      167      209
CWEDGE    540      5      160      167      209      161      168      210
```

PROBLEM B-II

VARIABLE CROSS-SECTIONS

This problem demonstrates the variable cross-section feature of JIG and its use with the 3-D solid wedge elements. Figures B-12 and B-13 show the configuration and the planned finite element model used in representing a bayonet joint. To develop the finite element model the joint was broken into two sections. Section A the female and Section B the male part. The I-J mesh used in defining each section is shown in Figures B-14 and B-15. A complete listing of the data input for each section is shown in Figures B-16 and B-17. Figures B-18 through B-21 show the grid point and element identification numbers as generated by JIG. Figures B-22 through B-25 gives a structural plot of the finite element model and is followed by a listing of the JIG punched output.

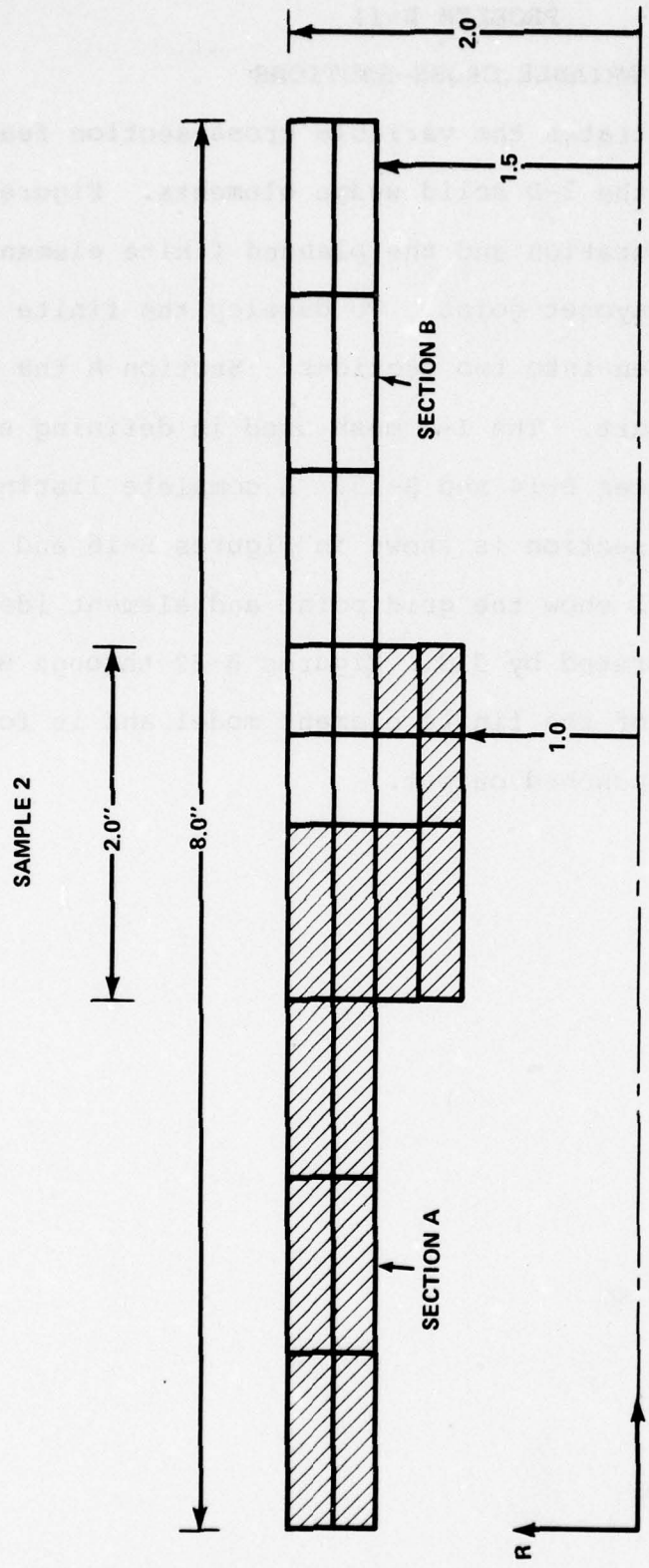


FIG. B-12 PLANNED FINITE ELEMENT MODEL AND CONFIGURATION OF A BAYONET JOINT.

SAMPLE 2

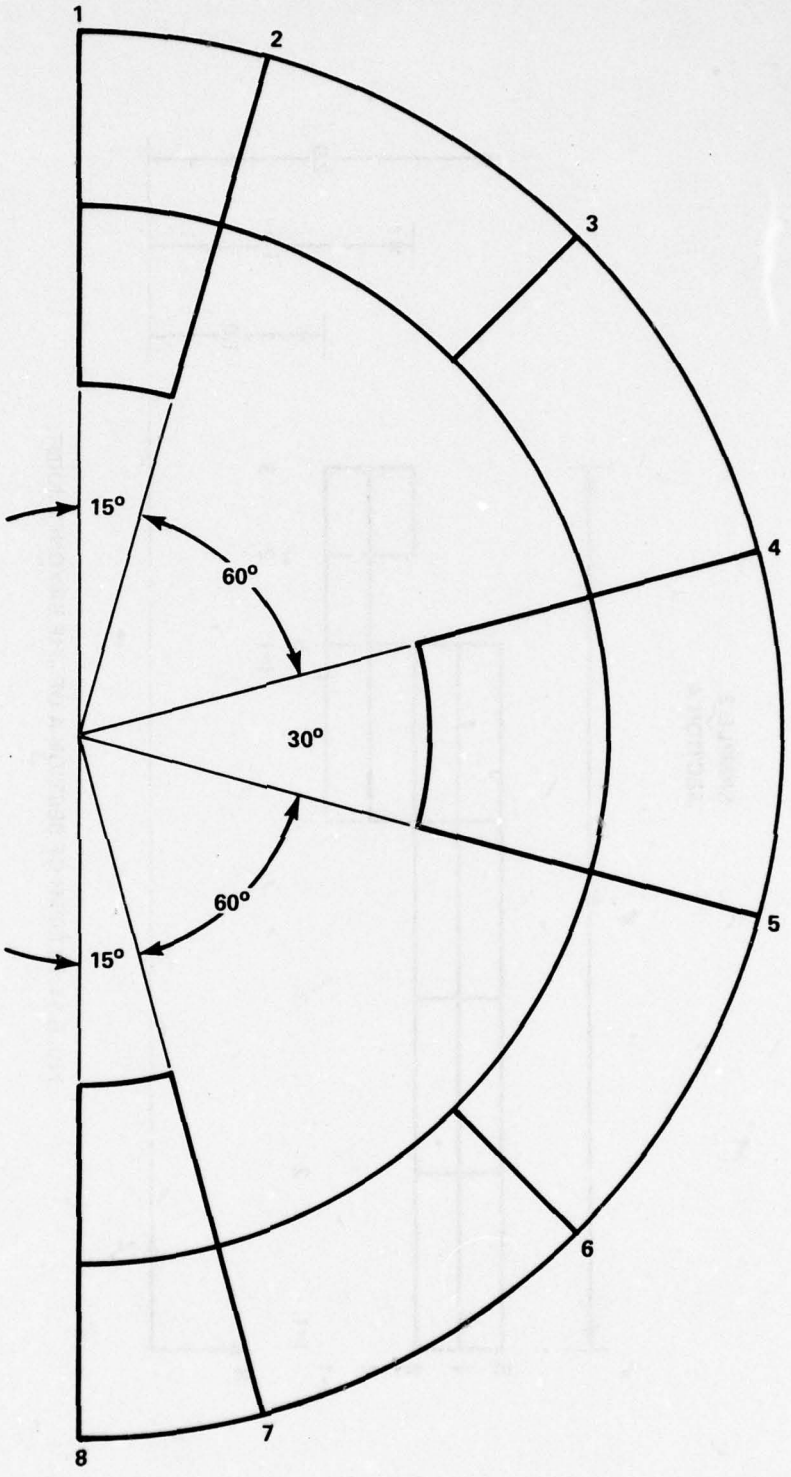


FIG. B-13 PLANNED FINITE ELEMENT MODEL AND CONFIGURATION OF A BAYONET JOINT.

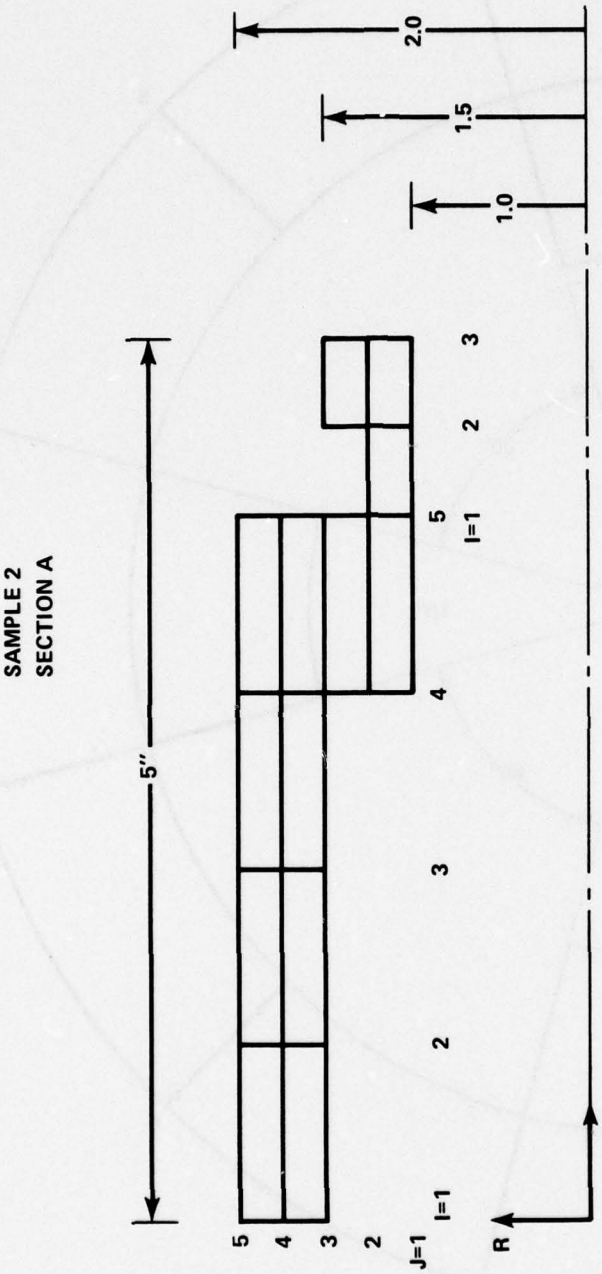


FIG. B-14 I-J MESH OF SECTION A OF THE BAYONET JOINT.

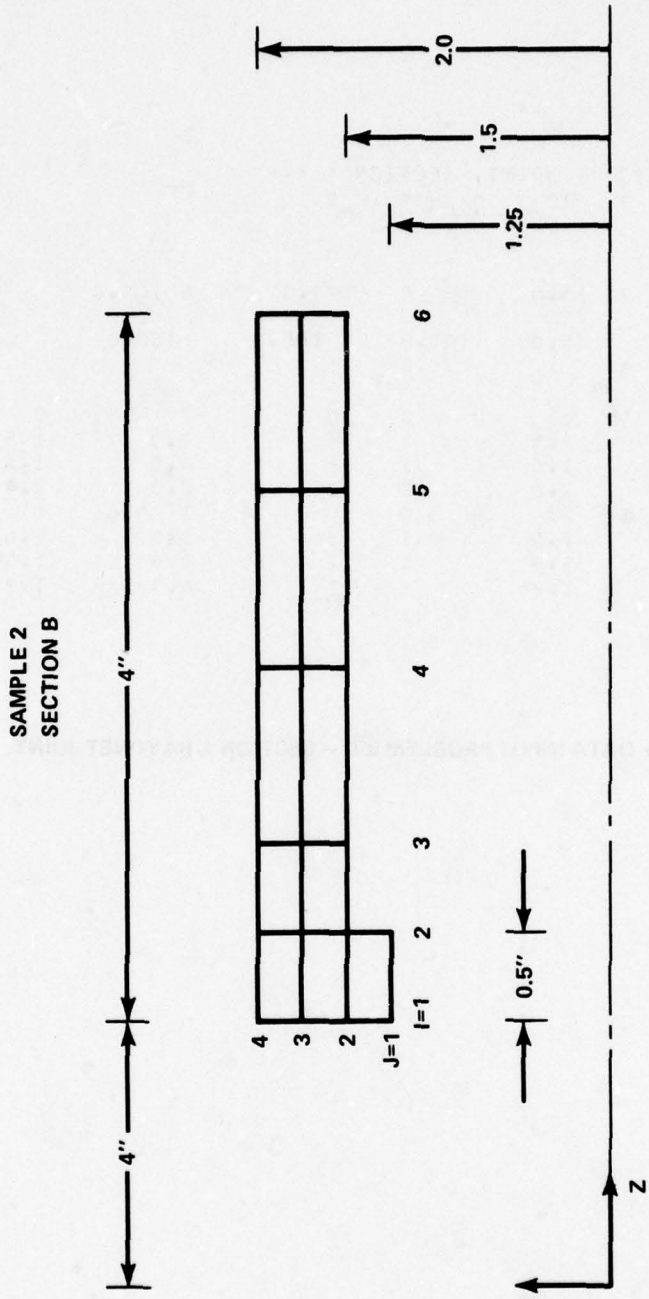


FIG. B-15 I-J MESH OF SECTION B OF THE BAYONET JOINT.

```
*** SAMPLE 2 - BAYONET JOINT, SECTION A ***
   2    1    1    3   10    0    1    5
   1    1
 0.0        0.0
   5    1   30
   1   0.0         2  15.0         4   75.0        5 105.0          7   165.0
   8  180.0
 0.0       15.0        75.0     105.0      165.0      180.0
   1    5    3    5    1    5    3    5
   1    5
   6    1    5    1    5    0    0    0    1   2  456     0
   1    3   0.0        1.5         1    4    3   3.0        1.5         1
   4    1   3.0        1.0         1    5    1   4.0        1.0         1
   5    5   4.0        2.0         1    1    5   0.0        2.0         1
   6    1    3    1    3    0    0    0    1   1  456     0
   1    1   4.0        1.0         1    3    1   5.0        1.0         1
   3    3   5.0        1.5         1    2    3   4.5        1.5         1
   2    2   4.5        1.25        1    1    2   4.0        1.25        1
```

FIG. B-16 DATA INPUT PROBLEM B-II – SECTION A BAYONET JOINT.

```
*** SAMPLE 2 - BAYONET JOINT, SECTION B
    1  201  250     3    10     0     1     5
    1
  0.0
    5     1    30
    1     0.0          2  15.0          4     75.0        5 105.0          7     165.0
    8     180.0
  0.0          15.0          75.0          105.0          165.0          180.0
    1     4     2     4     1     4     2     4
    1     4
    6     1     4     1     6     0     0     0     1     1  456      0
    1     1    4.0          1.25          1     2     1     4.5          1.25          1
    2     2    4.5          1.5           1     6     2     8.0          1.5           1
    6     4    8.0          2.0           1     1     4     4.0          2.0           1
```

FIG. B-17 DATA INPUT PROBLEM B-II – SECTION B BAYONET JOINT.

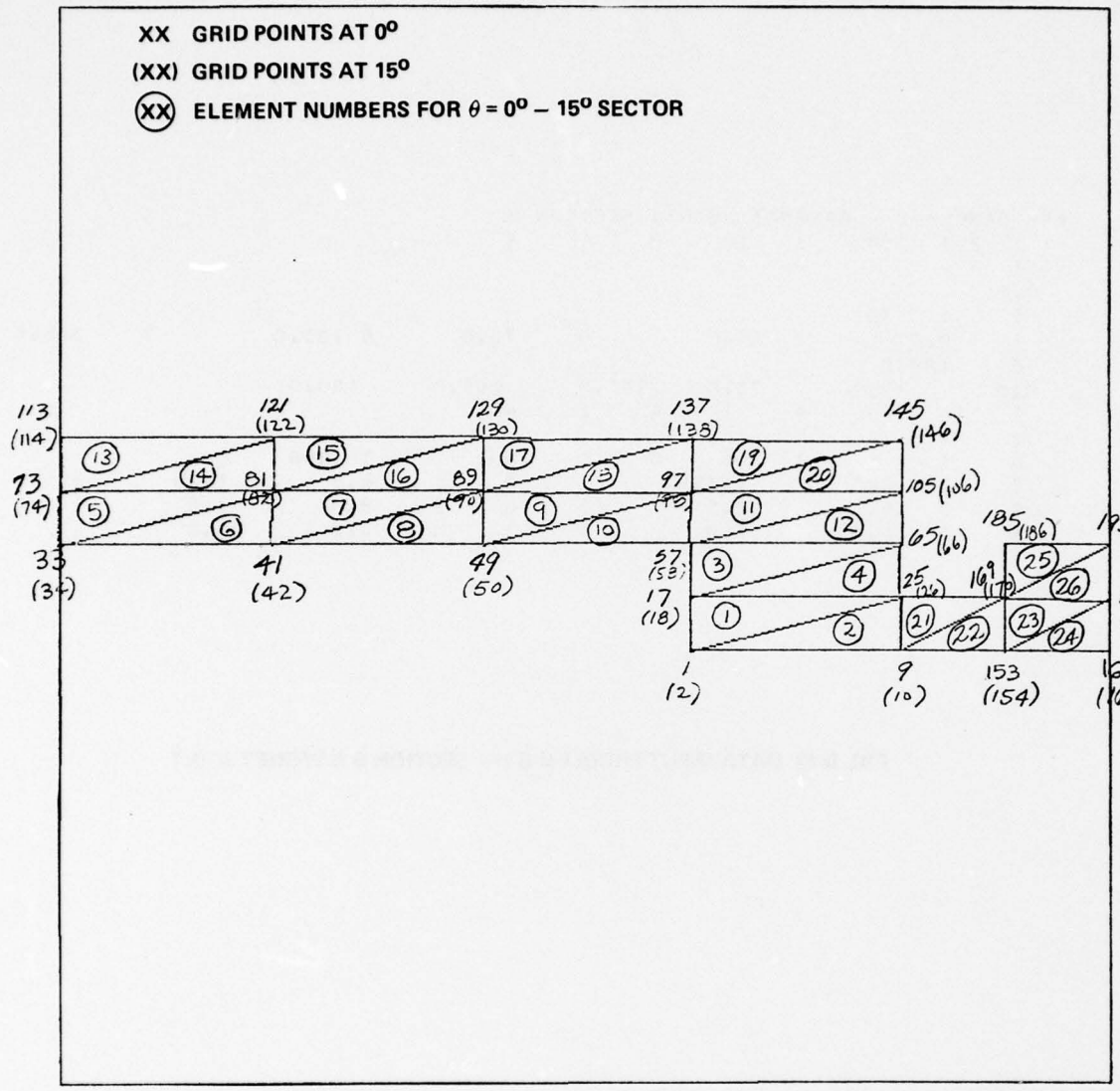


FIG. B-18 GRID POINT AND ELEMENT NUMBERS - 0° – 15° SECTOR

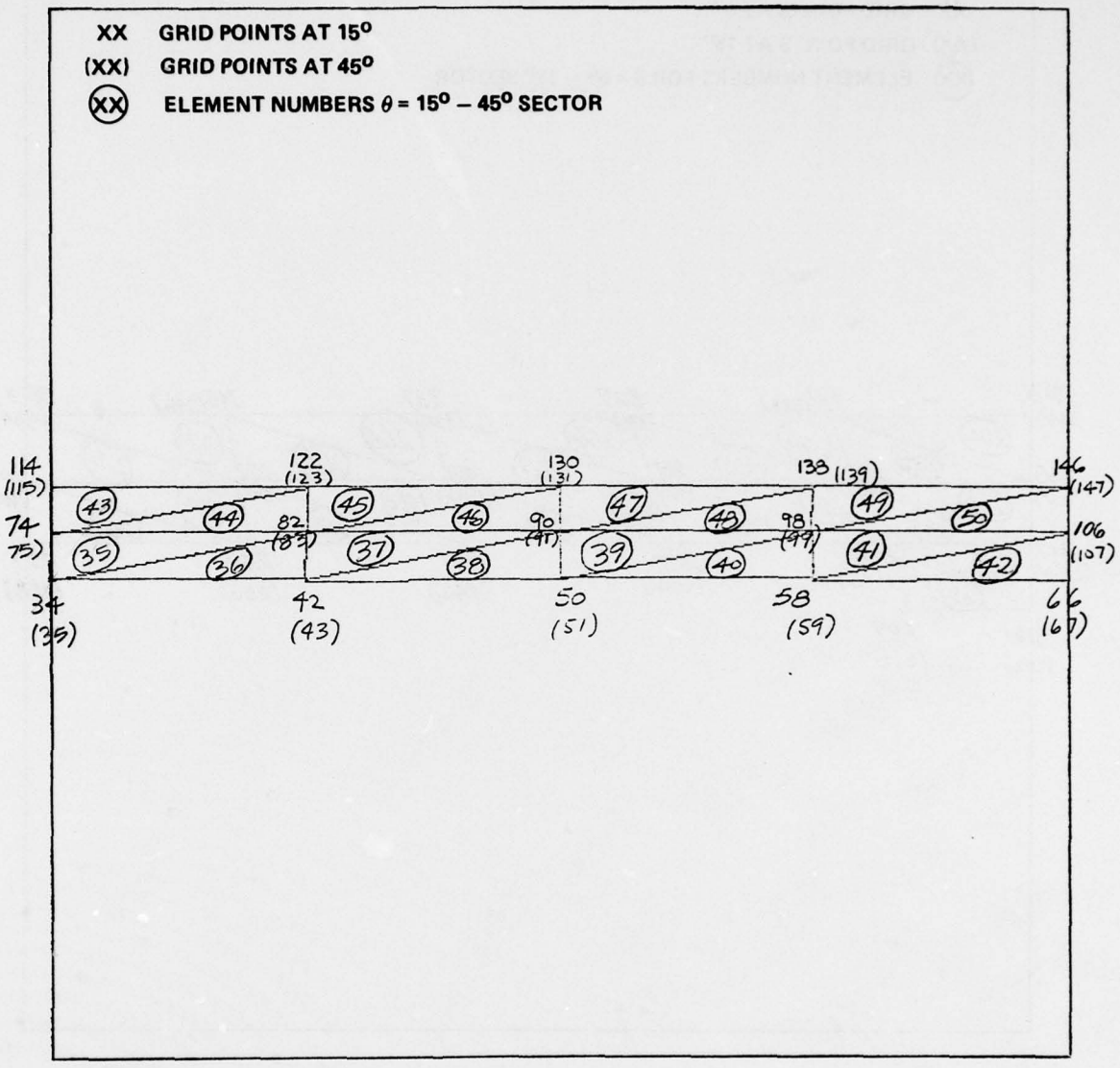


FIG. B-19 GRID POINT AND ELEMENT NUMBERS 15° TO 45° SECTOR

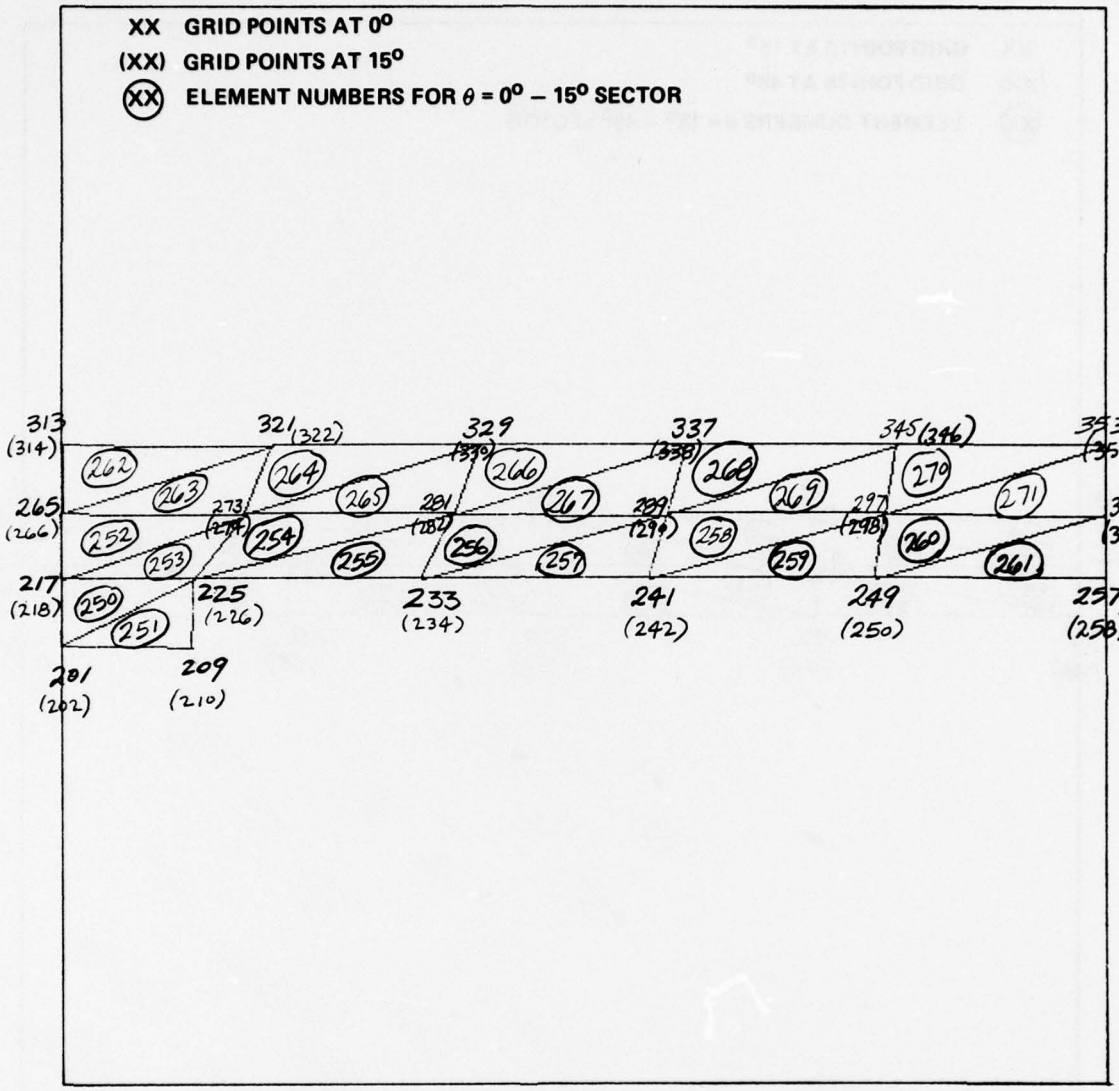


FIG. B-20 GRID POINT AND ELEMENT NUMBERS 0° TO 15° SECTOR

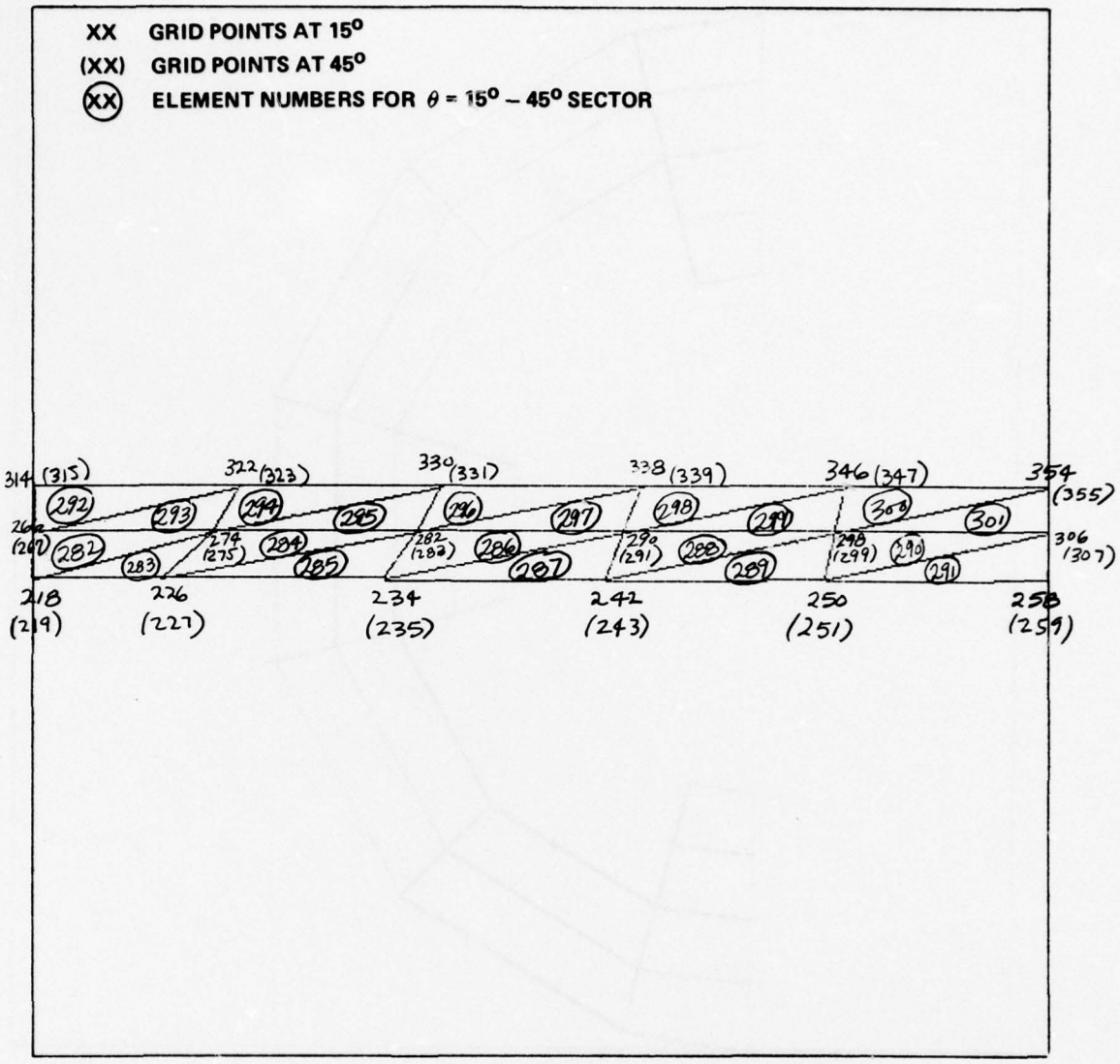


FIG. B-21 GRID POINT AND ELEMENT NUMBERS 15° TO 45° SECTOR

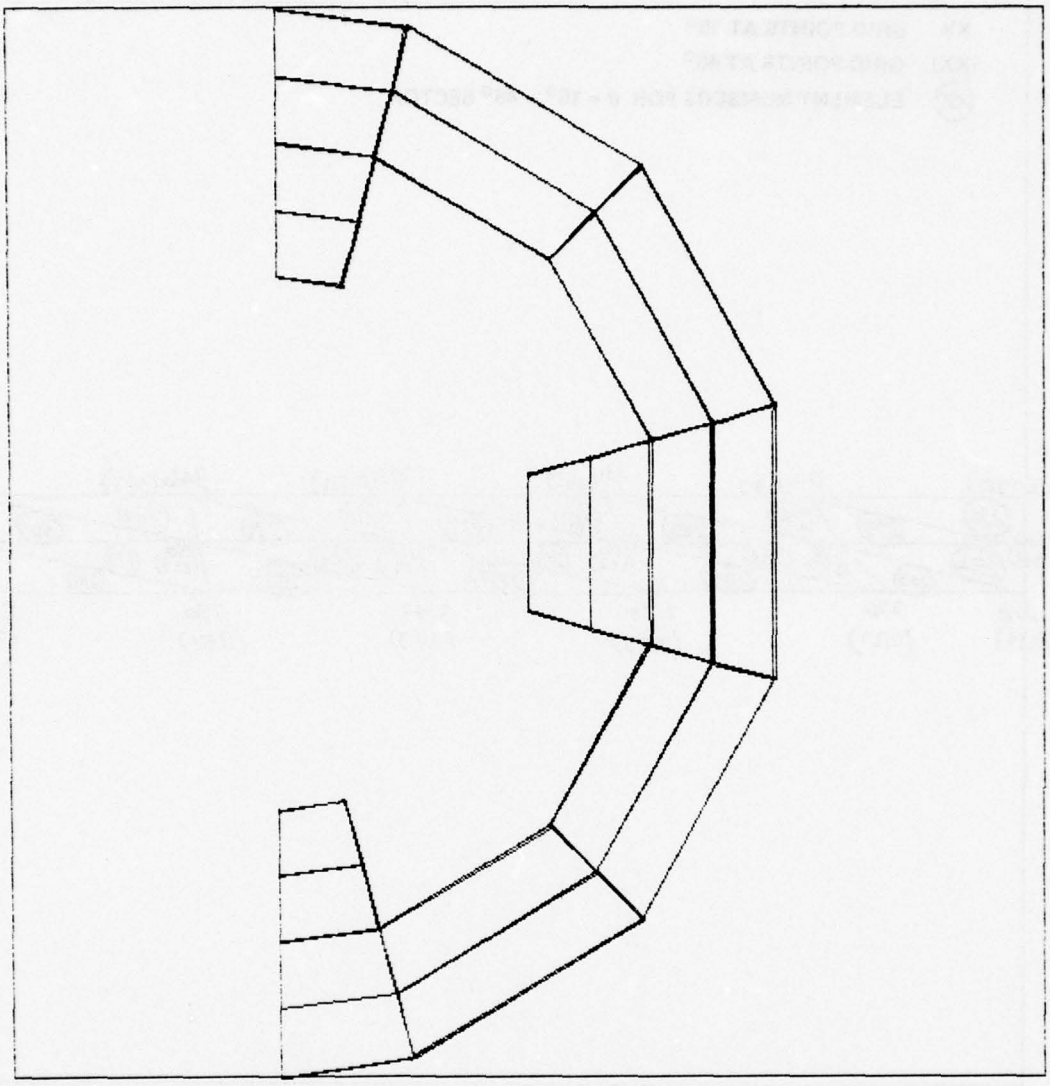


FIG. B-22 NASTRAN STRUCTURAL PLOT - END VIEW - SECTION A

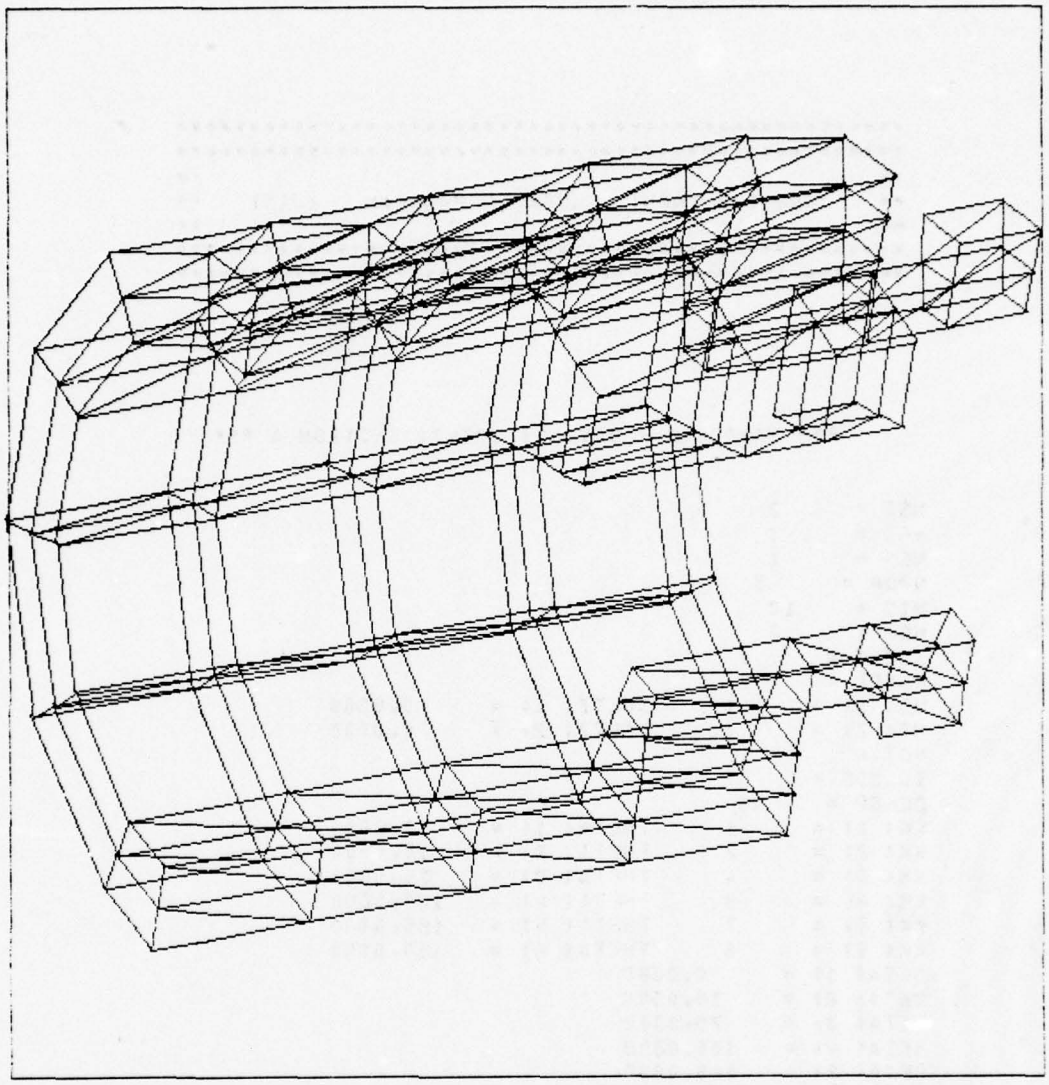


FIG. B-23 NASTRAN STRUCTURAL PLOT - ROTATED VIEW - SECTION A

LISTING OF PUNCHED NASTRAN BULK DATA CARDS
PROBLEM B-II VARIABLE CROSS SECTION SECTION A

```
**************************************************
**************************************************
**                                              **
**   JUNCTION INPUT GENERATOR PROGRAM   (JIG)   **
**                                              **
**************************************************
**************************************************
```

*** SAMPLE 2 - BAYONET JOINT, SECTION A ***

```
NST =      2
NGS =      1
NES =      1
NPOP =     3
MID =     10
NGP =      0
IDELT =    1
NSECT =    5
NT( 1) =     1     DELTZ( 1) =     0.0000
NT( 2) =     1     DELTZ( 2) =     0.0000
NDT =      5
ICLOSE =   1
DELGP =   30
KK( 1) =     1     THETA( 1) =     0.0000
KK( 2) =     2     THETA( 2) =    15.0000
KK( 3) =     4     THETA( 3) =    75.0000
KK( 4) =     5     THETA( 4) =   105.0000
KK( 5) =     7     THETA( 5) =   165.0000
KK( 6) =     8     THETA( 6) =   180.0000
BETA( 1) =    0.0000
BETA( 2) =   15.0000
BETA( 3) =   75.0000
BETA( 4) =  105.0000
BETA( 5) =  165.0000
BETA( 6) =  180.0000
JB( 1) =     1     JE( 1) =     5
JB( 2) =     3     JE( 2) =     5
JB( 3) =     1     JE( 3) =     5
JB( 4) =     3     JE( 4) =     5
JB( 5) =     1     JE( 5) =     5
```

I	J	Z(I,J)	X(I,J)	CODE(I,J)
4	1	3.00000	1.00000	1
5	1	4.00000	1.00000	1
4	2	3.00000	1.25000	1
5	2	4.00000	1.25000	1
1	3	0.00000	1.50000	1
2	3	1.00000	1.50000	1
3	3	2.00000	1.50000	1
4	3	3.00000	1.50000	1
5	3	4.00000	1.50000	1
1	4	0.00000	1.75000	1
2	4	1.00000	1.75000	0
3	4	2.00000	1.75001	0
4	4	3.00002	1.75002	0
5	4	4.00000	1.75000	1
1	5	0.00000	2.00000	1
2	5	1.00000	2.00000	1
3	5	2.00000	2.00000	1
4	5	3.00000	2.00000	1
5	5	4.00000	2.00000	1

```
GRID          1        1  1.0000   0.0000   3.0000        1      456
GRID          2        1  1.0000  15.0000   3.0000        1      456
GRID          4        1  1.0000  75.0000   3.0000        1      456
GRID          5        1  1.0000 105.0000   3.0000        1      456
GRID          7        1  1.0000 165.0000   3.0000        1      456
GRID          8        1  1.0000 180.0000   3.0000        1      456
GRID          9        1  1.0000   0.0000   4.0000        1      456
GRID         10        1  1.0000  15.0000   4.0000        1      456
GRID         12        1  1.0000  75.0000   4.0000        1      456
GRID         13        1  1.0000 105.0000   4.0000        1      456
GRID         15        1  1.0000 165.0000   4.0000        1      456
GRID         16        1  1.0000 180.0000   4.0000        1      456
GRID         17        1  1.2500   0.0000   3.0000        1      456
GRID         18        1  1.2500  15.0000   3.0000        1      456
GRID         20        1  1.2500  75.0000   3.0000        1      456
GRID         21        1  1.2500 105.0000   3.0000        1      456
GRID         23        1  1.2500 165.0000   3.0000        1      456
GRID         24        1  1.2500 180.0000   3.0000        1      456
GRID         25        1  1.2500   0.0000   4.0000        1      456
GRID         26        1  1.2500  15.0000   4.0000        1      456
GRID         28        1  1.2500  75.0000   4.0000        1      456
GRID         29        1  1.2500 105.0000   4.0000        1      456
GRID         31        1  1.2500 165.0000   4.0000        1      456
GRID         32        1  1.2500 180.0000   4.0000        1      456
CWEDGE        1       10      25       17        1       26       18        2
CWEDGE       91       10      28       20        4       29       21        5
CWEDGE      181       10      31       23        7       32       24        8
CWEDGE        2       10       1        9       25        2       10       26
CWEDGE       92       10       4       12       28        5       13       29
CWEDGE      182       10       7       15       31        8       16       32
GRID         33        1  1.5000   0.0000   0.0000        1      456
GRID         34        1  1.5000  15.0000   0.0000        1      456
GRID         35        1  1.5000  45.0000   0.0000        1      456
GRID         36        1  1.5000  75.0000   0.0000        1      456
GRID         37        1  1.5000 105.0000   0.0000        1      456
GRID         38        1  1.5000 135.0000   0.0000        1      456
GRID         39        1  1.5000 165.0000   0.0000        1      456
GRID         40        1  1.5000 180.0000   0.0000        1      456
GRID         41        1  1.5000   0.0000   1.0000        1      456
```

```
GRID       42       1  1.5000 15.0000  1.0000       1     456
GRID       43       1  1.5000 45.0000  1.0000       1     456
GRID       44       1  1.5000 75.0000  1.0000       1     456
GRID       45       1  1.5000105.0000  1.0000       1     456
GRID       46       1  1.5000135.0000  1.0000       1     456
GRID       47       1  1.5000165.0000  1.0000       1     456
GRID       48       1  1.5000180.0000  1.0000       1     456
GRID       49       1  1.5000  0.0000  2.0000       1     456
GRID       50       1  1.5000 15.0000  2.0000       1     456
GRID       51       1  1.5000 45.0000  2.0000       1     456
GRID       52       1  1.5000 75.0000  2.0000       1     456
GRID       53       1  1.5000105.0000  2.0000       1     456
GRID       54       1  1.5000135.0000  2.0000       1     456
GRID       55       1  1.5000165.0000  2.0000       1     456
GRID       56       1  1.5000180.0000  2.0000       1     456
GRID       57       1  1.5000  0.0000  3.0000       1     456
GRID       58       1  1.5000 15.0000  3.0000       1     456
GRID       59       1  1.5000 45.0000  3.0000       1     456
GRID       60       1  1.5000 75.0000  3.0000       1     456
GRID       61       1  1.5000105.0000  3.0000       1     456
GRID       62       1  1.5000135.0000  3.0000       1     456
GRID       63       1  1.5000165.0000  3.0000       1     456
GRID       64       1  1.5000180.0000  3.0000       1     456
GRID       65       1  1.5000  0.0000  4.0000       1     456
GRID       66       1  1.5000 15.0000  4.0000       1     456
GRID       67       1  1.5000 45.0000  4.0000       1     456
GRID       68       1  1.5000 75.0000  4.0000       1     456
GRID       69       1  1.5000105.0000  4.0000       1     456
GRID       70       1  1.5000135.0000  4.0000       1     456
GRID       71       1  1.5000165.0000  4.0000       1     456
GRID       72       1  1.5000180.0000  4.0000       1     456
CWEDGE      3      10      65      57      17      66      58      18
CWEDGE     93      10      68      60      20      69      61      21
CWEDGE    183      10      71      63      23      72      64      24
CWEDGE      4      10      17      25      65      18      26      66
CWEDGE     94      10      20      28      68      21      29      69
CWEDGE    184      10      23      31      71      24      32      72
GRID       73       1  1.7500  0.0000  0.0000       1     456
GRID       74       1  1.7500 15.0000  0.0000       1     456
GRID       75       1  1.7500 45.0000  0.0000       1     456
GRID       76       1  1.7500 75.0000  0.0000       1     456
GRID       77       1  1.7500105.0000  0.0000       1     456
GRID       78       1  1.7500135.0000  0.0000       1     456
GRID       79       1  1.7500165.0000  0.0000       1     456
GRID       80       1  1.7500180.0000  0.0000       1     456
GRID       81       1  1.7500  0.0000  1.0000       1     456
GRID       82       1  1.7500 15.0000  1.0000       1     456
GRID       83       1  1.7500 45.0000  1.0000       1     456
GRID       84       1  1.7500 75.0000  1.0000       1     456
GRID       85       1  1.7500105.0000  1.0000       1     456
GRID       86       1  1.7500135.0000  1.0000       1     456
GRID       87       1  1.7500165.0000  1.0000       1     456
GRID       88       1  1.7500180.0000  1.0000       1     456
CWEDGE      5      10      81      73      33      82      74      34
CWEDGE     35      10      82      74      34      83      75      35
CWEDGE     65      10      83      75      35      84      76      36
CWEDGE     95      10      84      76      36      85      77      37
CWEDGE    125      10      85      77      37      86      78      38
CWEDGE    155      10      86      78      38      87      79      39
CWEDGE    185      10      87      79      39      88      80      40
CWEDGE      6      10      33      41      81      34      42      82
CWEDGE     36      10      34      42      82      35      43      83
CWEDGE     66      10      35      43      83      36      44      84
CWEDGE     96      10      36      44      84      37      45      85
```

```
CWEDGE   126   10    37    45    85    38    46    86
CWEDGE   156   10    38    46    86    39    47    87
CWEDGE   186   10    39    47    87    40    48    88
GRID      89    1 1.7500  0.0000 2.0000     1   456
GRID      90    1 1.7500 15.0000 2.0000     1   456
GRID      91    1 1.7500 45.0000 2.0000     1   456
GRID      92    1 1.7500 75.0000 2.0000     1   456
GRID      93    1 1.7500105.0000 2.0000     1   456
GRID      94    1 1.7500135.0000 2.0000     1   456
GRID      95    1 1.7500165.0000 2.0000     1   456
GRID      96    1 1.7500180.0000 2.0000     1   456
CWEDGE     7   10    89    81    41    90    82    42
CWEDGE    37   10    90    82    42    91    83    43
CWEDGE    67   10    91    83    43    92    84    44
CWEDGE    97   10    92    84    44    93    85    45
CWEDGE   127   10    93    85    45    94    86    46
CWEDGE   157   10    94    86    46    95    87    47
CWEDGE   187   10    95    87    47    96    88    48
CWEDGE     8   10    41    49    89    42    50    90
CWEDGE    38   10    42    50    90    43    51    91
CWEDGE    68   10    43    51    91    44    52    92
CWEDGE    98   10    44    52    92    45    53    93
CWEDGE   128   10    45    53    93    46    54    94
CWEDGE   158   10    46    54    94    47    55    95
CWEDGE   188   10    47    55    95    48    56    96
GRID      97    1 1.7500  0.0000 3.0000     1   456
GRID      98    1 1.7500 15.0000 3.0000     1   456
GRID      99    1 1.7500 45.0000 3.0000     1   456
GRID     100    1 1.7500 75.0000 3.0000     1   456
GRID     101    1 1.7500105.0000 3.0000     1   456
GRID     102    1 1.7500135.0000 3.0000     1   456
GRID     103    1 1.7500165.0000 3.0000     1   456
GRID     104    1 1.7500180.0000 3.0000     1   456
CWEDGE     9   10    97    89    49    98    90    50
CWEDGE    39   10    98    90    50    99    91    51
CWEDGE    69   10    99    91    51   100    92    52
CWEDGE    99   10   100    92    52   101    93    53
CWEDGE   129   10   101    93    53   102    94    54
CWEDGE   159   10   102    94    54   103    95    55
CWEDGE   189   10   103    95    55   104    96    56
CWEDGE    10   10    49    57    97    50    58    98
CWEDGE    40   10    50    58    98    51    59    99
CWEDGE    70   10    51    59    99    52    60   100
CWEDGE   100   10    52    60   100    53    61   101
CWEDGE   130   10    53    61   101    54    62   102
CWEDGE   160   10    54    62   102    55    63   103
CWEDGE   190   10    55    63   103    56    64   104
GRID     105    1 1.7500  0.0000 4.0000     1   456
GRID     106    1 1.7500 15.0000 4.0000     1   456
GRID     107    1 1.7500 45.0000 4.0000     1   456
GRID     108    1 1.7500 75.0000 4.0000     1   456
GRID     109    1 1.7500105.0000 4.0000     1   456
GRID     110    1 1.7500135.0000 4.0000     1   456
GRID     111    1 1.7500165.0000 4.0000     1   456
GRID     112    1 1.7500180.0000 4.0000     1   456
CWEDGE    11   10   105    97    57   106    98    58
CWEDGE    41   10   106    98    58   107    99    59
CWEDGE    71   10   107    99    59   108   100    60
CWEDGE   101   10   108   100    60   109   101    61
CWEDGE   131   10   109   101    61   110   102    62
CWEDGE   161   10   110   102    62   111   103    63
CWEDGE   191   10   111   103    63   112   104    64
CWEDGE    12   10    57    65   105    58    66   106
CWEDGE    42   10    58    66   106    59    67   107
```

```
CWEDGE    72    10      59      67     107      60      68     108
CWEDGE   102    10      60      68     108      61      69     109
CWEDGE   132    10      61      69     109      62      70     110
CWEDGE   162    10      62      70     110      63      71     111
CWEDGE   192    10      63      71     111      64      72     112
GRID     113     1  2.0000   0.0000  0.0000     1     456
GRID     114     1  2.0000  15.0000  0.0000     1     456
GRID     115     1  2.0000  45.0000  0.0000     1     456
GRID     116     1  2.0000  75.0000  0.0000     1     456
GRID     117     1  2.0000 105.0000  0.0000     1     456
GRID     118     1  2.0000 135.0000  0.0000     1     456
GRID     119     1  2.0000 165.0000  0.0000     1     456
GRID     120     1  2.0000 180.0000  0.0000     1     456
GRID     121     1  2.0000   0.0000  1.0000     1     456
GRID     122     1  2.0000  15.0000  1.0000     1     456
GRID     123     1  2.0000  45.0000  1.0000     1     456
GRID     124     1  2.0000  75.0000  1.0000     1     456
GRID     125     1  2.0000 105.0000  1.0000     1     456
GRID     126     1  2.0000 135.0000  1.0000     1     456
GRID     127     1  2.0000 165.0000  1.0000     1     456
GRID     128     1  2.0000 180.0000  1.0000     1     456
CWEDGE    13    10     121     113      73     122     114      74
CWEDGE    43    10     122     114      74     123     115      75
CWEDGE    73    10     123     115      75     124     116      76
CWEDGE   103    10     124     116      76     125     117      77
CWEDGE   133    10     125     117      77     126     118      78
CWEDGE   163    10     126     118      78     127     119      79
CWEDGE   193    10     127     119      79     128     120      80
CWEDGE    14    10      73      81     121      74      82     122
CWEDGE    44    10      74      82     122      75      83     123
CWEDGE    74    10      75      83     123      76      84     124
CWEDGE   104    10      76      84     124      77      85     125
CWEDGE   134    10      77      85     125      78      86     126
CWEDGE   164    10      78      86     126      79      87     127
CWEDGE   194    10      79      87     127      80      88     128
GRID     129     1  2.0000   0.0000  2.0000     1     456
GRID     130     1  2.0000  15.0000  2.0000     1     456
GRID     131     1  2.0000  45.0000  2.0000     1     456
GRID     132     1  2.0000  75.0000  2.0000     1     456
GRID     133     1  2.0000 105.0000  2.0000     1     456
GRID     134     1  2.0000 135.0000  2.0000     1     456
GRID     135     1  2.0000 165.0000  2.0000     1     456
GRID     136     1  2.0000 180.0000  2.0000     1     456
CWEDGE    15    10     129     121      81     130     122      82
CWEDGE    45    10     130     122      82     131     123      83
CWEDGE    75    10     131     123      83     132     124      84
CWEDGE   105    10     132     124      84     133     125      85
CWEDGE   135    10     133     125      85     134     126      86
CWEDGE   165    10     134     126      86     135     127      87
CWEDGE   195    10     135     127      87     136     128      88
CWEDGE    16    10      81      89     129      82      90     130
CWEDGE    46    10      82      90     130      83      91     131
CWEDGE    76    10      83      91     131      84      92     132
CWEDGE   106    10      84      92     132      85      93     133
CWEDGE   136    10      85      93     133      86      94     134
CWEDGE   166    10      86      94     134      87      95     135
CWEDGE   196    10      87      95     135      88      96     136
GRID     137     1  2.0000   0.0000  3.0000     1     456
GRID     138     1  2.0000  15.0000  3.0000     1     456
GRID     139     1  2.0000  45.0000  3.0000     1     456
GRID     140     1  2.0000  75.0000  3.0000     1     456
GRID     141     1  2.0000 105.0000  3.0000     1     456
GRID     142     1  2.0000 135.0000  3.0000     1     456
GRID     143     1  2.0000 165.0000  3.0000     1     456
```

```
GRID      144     1  2.0000180.0000  3.0000     1     456
CWEDGE     17    10     137     129      89     138   130    90
CWEDGE     47    10     138     130      90     139   131    91
CWEDGE     77    10     139     131      91     140   132    92
CWEDGE    107    10     140     132      92     141   133    93
CWEDGE    137    10     141     133      93     142   134    94
CWEDGE    167    10     142     134      94     143   135    95
CWEDGE    197    10     143     135      95     144   136    96
CWEDGE     18    10      89      97     137      90    98   138
CWEDGE     48    10      90      98     138      91    99   139
CWEDGE     78    10      91      99     139      92   100   140
CWEDGE    108    10      92     100     140      93   101   141
CWEDGE    138    10      93     101     141      94   102   142
CWEDGE    168    10      94     102     142      95   103   143
CWEDGE    198    10      95     103     143      96   104   144
GRID      145     1  2.0000   0.0000  4.0000     1     456
GRID      146     1  2.0000  15.0000  4.0000     1     456
GRID      147     1  2.0000  45.0000  4.0000     1     456
GRID      148     1  2.0000  75.0000  4.0000     1     456
GRID      149     1  2.0000105.0000  4.0000     1     456
GRID      150     1  2.0000135.0000  4.0000     1     456
GRID      151     1  2.0000165.0000  4.0000     1     456
GRID      152     1  2.0000180.0000  4.0000     1     456
CWEDGE     19    10     145     137      97     146   138    98
CWEDGE     49    10     146     138      98     147   139    99
CWEDGE     79    10     147     139      99     148   140   100
CWEDGE    109    10     148     140     100     149   141   101
CWEDGE    139    10     149     141     101     150   142   102
CWEDGE    169    10     150     142     102     151   143   103
CWEDGE    199    10     151     143     103     152   144   104
CWEDGE     20    10      97     105     145      98   106   146
CWEDGE     50    10      98     106     146      99   107   147
CWEDGE     80    10      99     107     147     100   108   148
CWEDGE    110    10     100     108     148     101   109   149
CWEDGE    140    10     101     109     149     102   110   150
CWEDGE    170    10     102     110     150     103   111   151
CWEDGE    200    10     103     111     151     104   112   152
```

```
    I     J      Z(I,J)        X(I,J)   CODE(I,J)

    1     1     4.00000       1.00000      1
    2     1     4.50000       1.00000      1
    3     1     5.00000       1.00000      1
    1     2     4.00000       1.25000      1
    2     2     4.50000       1.25000      1
    3     2     5.00000       1.25000      1
    2     3     4.50000       1.50000      1
    3     3     5.00000       1.50000      1
GRID      153     1  1.0000   0.0000  4.5000     1     456
GRID      154     1  1.0000  15.0000  4.5000     1     456
GRID      156     1  1.0000  75.0000  4.5000     1     456
GRID      157     1  1.0000105.0000  4.5000     1     456
GRID      159     1  1.0000165.0000  4.5000     1     456
GRID      160     1  1.0000180.0000  4.5000     1     456
GRID      161     1  1.0000   0.0000  5.0000     1     456
GRID      162     1  1.0000  15.0000  5.0000     1     456
GRID      164     1  1.0000  75.0000  5.0000     1     456
GRID      165     1  1.0000105.0000  5.0000     1     456
GRID      167     1  1.0000165.0000  5.0000     1     456
GRID      168     1  1.0000180.0000  5.0000     1     456
GRID      169     1  1.2500   0.0000  4.5000     1     456
GRID      170     1  1.2500  15.0000  4.5000     1     456
```

```
GRID      172       1  1.2500 75.0000  4.5000       1     456
GRID      173       1  1.2500105.0000  4.5000       1     456
GRID      175       1  1.2500165.0000  4.5000       1     456
GRID      176       1  1.2500180.0000  4.5000       1     456
CWEDGE     21      10     169      25       9     170      26      10
CWEDGE    111      10     172      28      12     173      29      13
CWEDGE    201      10     175      31      15     176      32      16
CWEDGE     22      10       9     153     169      10     154     170
CWEDGE    112      10      12     156     172      13     157     173
CWEDGE    202      10      15     159     175      16     160     176
GRID      177       1  1.2500   0.0000  5.0000       1     456
GRID      178       1  1.2500  15.0000  5.0000       1     456
GRID      180       1  1.2500  75.0000  5.0000       1     456
GRID      181       1  1.2500105.0000  5.0000       1     456
GRID      183       1  1.2500165.0000  5.0000       1     456
GRID      184       1  1.2500180.0000  5.0000       1     456
CWEDGE     23      10     177     169     153     178     170     154
CWEDGE    113      10     180     172     156     181     173     157
CWEDGE    203      10     183     175     159     184     176     160
CWEDGE     24      10     153     161     177     154     162     178
CWEDGE    114      10     156     164     180     157     165     181
CWEDGE    204      10     159     167     183     160     168     184
GRID      185       1  1.5000   0.0000  4.5000       1     456
GRID      186       1  1.5000  15.0000  4.5000       1     456
GRID      188       1  1.5000  75.0000  4.5000       1     456
GRID      189       1  1.5000105.0000  4.5000       1     456
GRID      191       1  1.5000165.0000  4.5000       1     456
GRID      192       1  1.5000180.0000  4.5000       1     456
GRID      193       1  1.5000   0.0000  5.0000       1     456
GRID      194       1  1.5000  15.0000  5.0000       1     456
GRID      196       1  1.5000  75.0000  5.0000       1     456
GRID      197       1  1.5000105.0000  5.0000       1     456
GRID      199       1  1.5000165.0000  5.0000       1     456
GRID      200       1  1.5000180.0000  5.0000       1     456
CWEDGE     25      10     193     185     169     194     186     170
CWEDGE    115      10     196     188     172     197     189     173
CWEDGE    205      10     199     191     175     200     192     176
CWEDGE     26      10     169     177     193     170     178     194
CWEDGE    116      10     172     180     196     173     181     197
CWEDGE    206      10     175     183     199     176     184     200
```

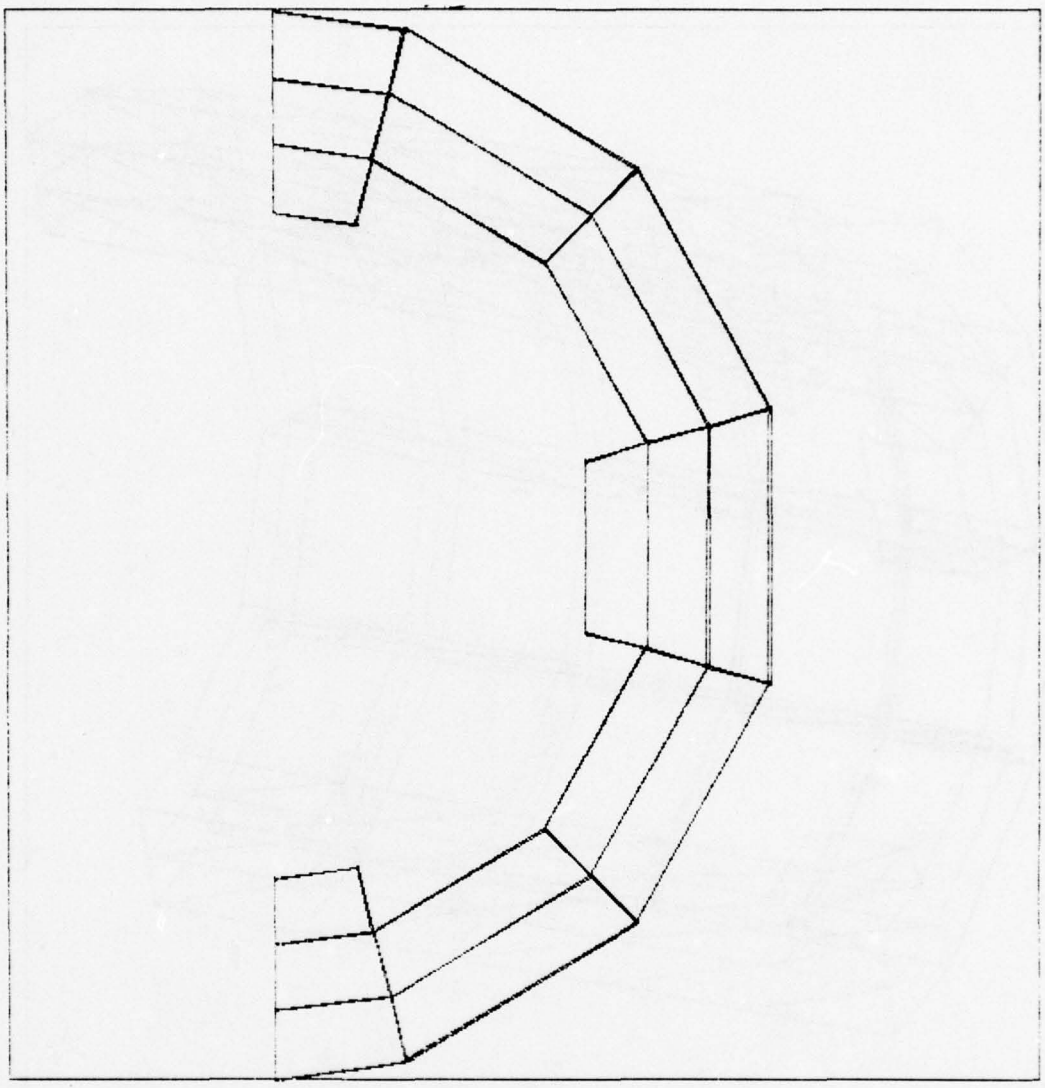


FIG. B-24 NASTRAN STRUCTURAL PLOT - END VIEW - SECTION B

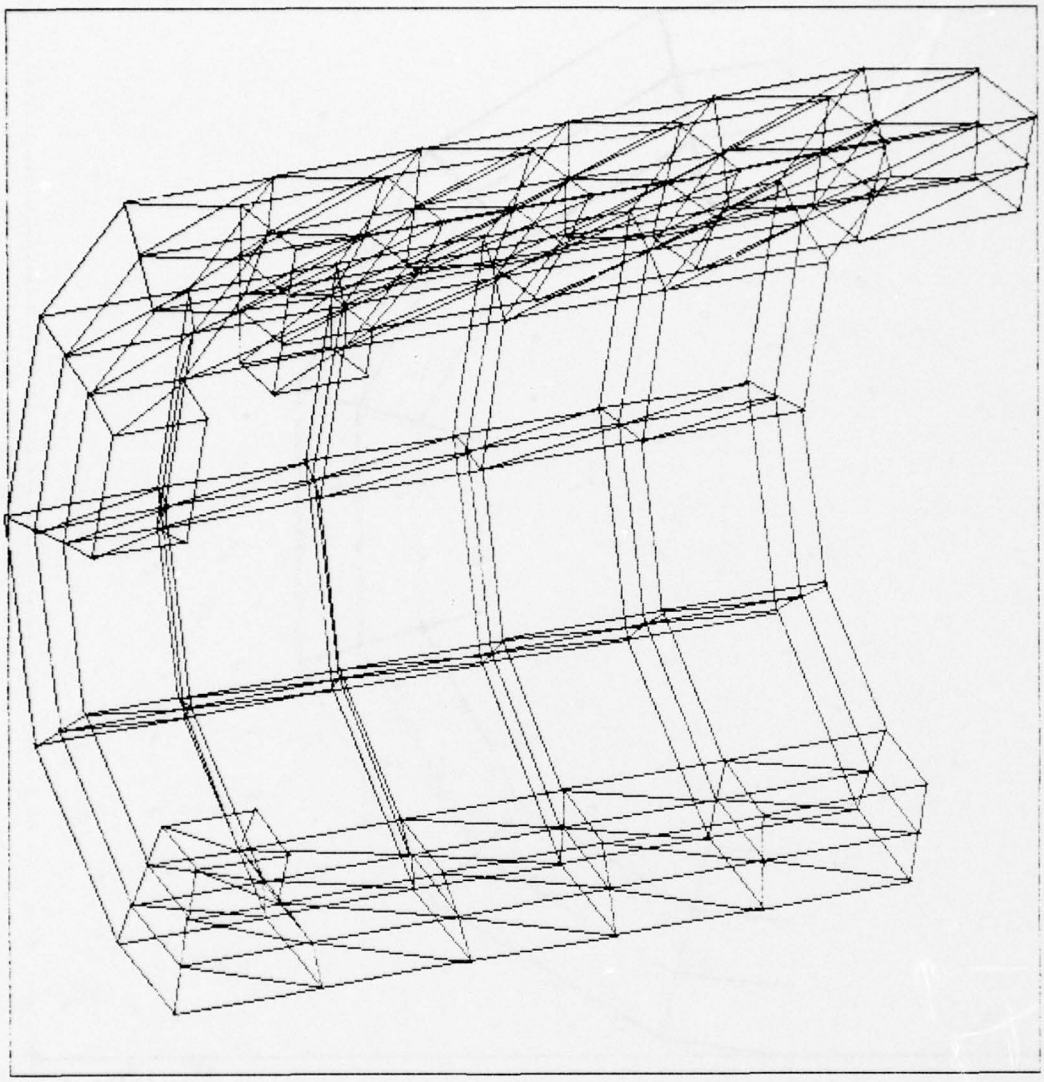


FIG. B-25 NASTRAN STRUCTURAL PLOT - ROTATED VIEW - SECTION B

LISTING OF PUNCHED NASTRAN BULK DATA CARDS
PROBLEM B-II VARIABLE CROSS SECTIONS SECTION B

```
**************************************************
**************************************************
**                                              **
**   JUNCTION INPUT GENERATOR PROGRAM   (JIG)   **
**                                              **
**************************************************
**************************************************
```

*** SAMPLE 2 - BAYONET JOINT, SECTION B

```
NST =      1
NGS =    201
NES =    250
NPOP =     3
MID =     10
NGP =      0
IDELT =      1
NSECT =      5
NT( 1) =      1      DELTZ( 1) =      0.0000
NDT =      5
ICLOSE =      1
DELGP =     30
KK( 1) =      1      THETA( 1) =      0.0000
KK( 2) =      2      THETA( 2) =     15.0000
KK( 3) =      4      THETA( 3) =     75.0000
KK( 4) =      5      THETA( 4) =    105.0000
KK( 5) =      7      THETA( 5) =    165.0000
KK( 6) =      8      THETA( 6) =    180.0000
BETA( 1) =     0.0000
BETA( 2) =    15.0000
BETA( 3) =    75.0000
BETA( 4) =   105.0000
BETA( 5) =   165.0000
BETA( 6) =   180.0000
JB( 1) =      1      JE( 1) =      4
JB( 2) =      2      JE( 2) =      4
JB( 3) =      1      JE( 3) =      4
JB( 4) =      2      JE( 4) =      4
JB( 5) =      1      JE( 5) =      4
```

I	J	Z(I,J)	X(I,J)	CODE(I,J)
1	1	4.00000	1.25000	1
2	1	4.50000	1.25000	1
1	2	4.00000	1.50000	1
2	2	4.50000	1.50000	1
3	2	5.37500	1.50000	1
4	2	6.25000	1.50000	1
5	2	7.12500	1.50000	1
6	2	8.00000	1.50000	1
1	3	4.00000	1.75000	1
2	3	4.70028	1.75001	0
3	3	5.50098	1.75000	0
4	3	6.32855	1.74999	0
5	3	7.16345	1.75002	0
6	3	8.00000	1.75000	1
1	4	4.00000	2.00000	1
2	4	4.80000	2.00000	1
3	4	5.60000	2.00000	1
4	4	6.40000	2.00000	1
5	4	7.20000	2.00000	1
6	4	8.00000	2.00000	1

```
GRID          201        1  1.2500   0.0000   4.0000        1      456
GRID          202        1  1.2500  15.0000   4.0000        1      456
GRID          204        1  1.2500  75.0000   4.0000        1      456
GRID          205        1  1.2500 105.0000   4.0000        1      456
GRID          207        1  1.2500 165.0000   4.0000        1      456
GRID          208        1  1.2500 180.0000   4.0000        1      456
GRID          209        1  1.2500   0.0000   4.5000        1      456
GRID          210        1  1.2500  15.0000   4.5000        1      456
GRID          212        1  1.2500  75.0000   4.5000        1      456
GRID          213        1  1.2500 105.0000   4.5000        1      456
GRID          215        1  1.2500 165.0000   4.5000        1      456
GRID          216        1  1.2500 180.0000   4.5000        1      456
GRID          217        1  1.5000   0.0000   4.0000        1      456
GRID          218        1  1.5000  15.0000   4.0000        1      456
GRID          219        1  1.5000  45.0000   4.0000        1      456
GRID          220        1  1.5000  75.0000   4.0000        1      456
GRID          221        1  1.5000 105.0000   4.0000        1      456
GRID          222        1  1.5000 135.0000   4.0000        1      456
GRID          223        1  1.5000 165.0000   4.0000        1      456
GRID          224        1  1.5000 180.0000   4.0000        1      456
GRID          225        1  1.5000   0.0000   4.5000        1      456
GRID          226        1  1.5000  15.0000   4.5000        1      456
GRID          227        1  1.5000  45.0000   4.5000        1      456
GRID          228        1  1.5000  75.0000   4.5000        1      456
GRID          229        1  1.5000 105.0000   4.5000        1      456
GRID          230        1  1.5000 135.0000   4.5000        1      456
GRID          231        1  1.5000 165.0000   4.5000        1      456
GRID          232        1  1.5000 180.0000   4.5000        1      456
CWEDGE        250       10     225      217      201      226      218      202
CWEDGE        340       10     228      220      204      229      221      205
CWEDGE        430       10     231      223      207      232      224      208
CWEDGE        251       10     201      209      225      202      210      226
CWEDGE        341       10     204      212      228      205      213      229
CWEDGE        431       10     207      215      231      208      216      232
GRID          233        1  1.5000   0.0000   5.3750        1      456
GRID          234        1  1.5000  15.0000   5.3750        1      456
GRID          235        1  1.5000  45.0000   5.3750        1      456
GRID          236        1  1.5000  75.0000   5.3750        1      456
```

```
GRID           237       1  1.5000135.0000   5.3750       1       456
GRID           238       1  1.5000135.0000   5.3750       1       456
GRID           239       1  1.5000165.0000   5.3750       1       456
GRID           240       1  1.5000180.0000   5.3750       1       456
GRID           241       1  1.5000   0.0000  6.2500       1       456
GRID           242       1  1.5000  15.0000  6.2500       1       456
GRID           243       1  1.5000  45.0000  6.2500       1       456
GRID           244       1  1.5000  75.0000  6.2500       1       456
GRID           245       1  1.5000105.0000   6.2500       1       456
GRID           246       1  1.5000135.0000   6.2500       1       456
GRID           247       1  1.5000165.0000   6.2500       1       456
GRID           248       1  1.5000180.0000   6.2500       1       456
GRID           249       1  1.5000   0.0000  7.1250       1       456
GRID           250       1  1.5000  15.0000  7.1250       1       456
GRID           251       1  1.5000  45.0000  7.1250       1       456
GRID           252       1  1.5000  75.0000  7.1250       1       456
GRID           253       1  1.5000105.0000   7.1250       1       456
GRID           254       1  1.5000135.0000   7.1250       1       456
GRID           255       1  1.5000165.0000   7.1250       1       456
GRID           256       1  1.5000180.0000   7.1250       1       456
GRID           257       1  1.5000   0.0000  8.0000       1       456
GRID           258       1  1.5000  15.0000  8.0000       1       456
GRID           259       1  1.5000  45.0000  8.0000       1       456
GRID           260       1  1.5000  75.0000  8.0000       1       456
GRID           261       1  1.5000105.0000   8.0000       1       456
GRID           262       1  1.5000135.0000   8.0000       1       456
GRID           263       1  1.5000165.0000   8.0000       1       456
GRID           264       1  1.5000180.0000   8.0000       1       456
GRID           265       1  1.7500   0.0000  4.0000       1       456
GRID           266       1  1.7500  15.0000  4.0000       1       456
GRID           267       1  1.7500  45.0000  4.0000       1       456
GRID           268       1  1.7500  75.0000  4.0000       1       456
GRID           269       1  1.7500105.0000   4.0000       1       456
GRID           270       1  1.7500135.0000   4.0000       1       456
GRID           271       1  1.7500165.0000   4.0000       1       456
GRID           272       1  1.7500180.0000   4.0000       1       456
GRID           273       1  1.7500   0.0000  4.7003       1       456
GRID           274       1  1.7500  15.0000  4.7003       1       456
GRID           275       1  1.7500  45.0000  4.7003       1       456
GRID           276       1  1.7500  75.0000  4.7003       1       456
GRID           277       1  1.7500105.0000   4.7003       1       456
GRID           278       1  1.7500135.0000   4.7003       1       456
GRID           279       1  1.7500165.0000   4.7003       1       456
GRID           280       1  1.7500180.0000   4.7003       1       456
CWEDGE         252      10     273     265     217     274     266     218
CWEDGE         282      10     274     266     218     275     267     219
CWEDGE         312      10     275     267     219     276     268     220
CWEDGE         342      10     276     268     220     277     269     221
CWEDGE         372      10     277     269     221     278     270     222
CWEDGE         402      10     278     270     222     279     271     223
CWEDGE         432      10     279     271     223     280     272     224
CWEDGE         253      10     217     225     273     218     226     274
CWEDGE         283      10     218     226     274     219     227     275
CWEDGE         313      10     219     227     275     220     228     276
CWEDGE         343      10     220     228     276     221     229     277
CWEDGE         373      10     221     229     277     222     230     278
CWEDGE         403      10     222     230     278     223     231     279
CWEDGE         433      10     223     231     279     224     232     280
GRID           281       1  1.7500   0.0000  5.5010       1       456
GRID           282       1  1.7500  15.0000  5.5010       1       456
GRID           283       1  1.7500  45.0000  5.5010       1       456
GRID           284       1  1.7500  75.0000  5.5010       1       456
GRID           285       1  1.7500105.0000   5.5010       1       456
GRID           286       1  1.7500135.0000   5.5010       1       456
```

```
GRID      287       1  1.7500165.0000  5.5010       1     456
GRID      288       1  1.7500180.0000  5.5010       1     456
CWEDGE    254      10     281     273     225     282     274     226
CWEDGE    284      10     282     274     226     283     275     227
CWEDGE    314      10     283     275     227     284     276     228
CWEDGE    344      10     284     276     228     285     277     229
CWEDGE    374      10     285     277     229     286     278     230
CWEDGE    404      10     286     278     230     287     279     231
CWEDGE    434      10     287     279     231     288     280     232
CWEDGE    255      10     225     233     281     226     234     282
CWEDGE    285      10     226     234     282     227     235     283
CWEDGE    315      10     227     235     283     228     236     284
CWEDGE    345      10     228     236     284     229     237     285
CWEDGE    375      10     229     237     285     230     238     286
CWEDGE    405      10     230     238     286     231     239     287
CWEDGE    435      10     231     239     287     232     240     288
GRID      289       1  1.7500   0.0000  6.3286       1     456
GRID      290       1  1.7500  15.0000  6.3286       1     456
GRID      291       1  1.7500  45.0000  6.3286       1     456
GRID      292       1  1.7500  75.0000  6.3286       1     456
GRID      293       1  1.7500105.0000  6.3286       1     456
GRID      294       1  1.7500135.0000  6.3286       1     456
GRID      295       1  1.7500165.0000  6.3286       1     456
GRID      296       1  1.7500180.0000  6.3286       1     456
CWEDGE    256      10     289     281     233     290     282     234
CWEDGE    286      10     290     282     234     291     283     235
CWEDGE    316      10     291     283     235     292     284     236
CWEDGE    346      10     292     284     236     293     285     237
CWEDGE    376      10     293     285     237     294     286     238
CWEDGE    406      10     294     286     238     295     287     239
CWEDGE    436      10     295     287     239     296     288     240
CWEDGE    257      10     233     241     289     234     242     290
CWEDGE    287      10     234     242     290     235     243     291
CWEDGE    317      10     235     243     291     236     244     292
CWEDGE    347      10     236     244     292     237     245     293
CWEDGE    377      10     237     245     293     238     246     294
CWEDGE    407      10     238     246     294     239     247     295
CWEDGE    437      10     239     247     295     240     248     296
GRID      297       1  1.7500   0.0000  7.1635       1     456
GRID      298       1  1.7500  15.0000  7.1635       1     456
GRID      299       1  1.7500  45.0000  7.1635       1     456
GRID      300       1  1.7500  75.0000  7.1635       1     456
GRID      301       1  1.7500105.0000  7.1635       1     456
GRID      302       1  1.7500135.0000  7.1635       1     456
GRID      303       1  1.7500165.0000  7.1635       1     456
GRID      304       1  1.7500180.0000  7.1635       1     456
CWEDGE    258      10     297     289     241     298     290     242
CWEDGE    288      10     298     290     242     299     291     243
CWEDGE    318      10     299     291     243     300     292     244
CWEDGE    348      10     300     292     244     301     293     245
CWEDGE    378      10     301     293     245     302     294     246
CWEDGE    408      10     302     294     246     303     295     247
CWEDGE    438      10     303     295     247     304     296     248
CWEDGE    259      10     241     249     297     242     250     298
CWEDGE    289      10     242     250     298     243     251     299
CWEDGE    319      10     243     251     299     244     252     300
CWEDGE    349      10     244     252     300     245     253     301
CWEDGE    379      10     245     253     301     246     254     302
CWEDGE    409      10     246     254     302     247     255     303
CWEDGE    439      10     247     255     303     248     256     304
GRID      305       1  1.7500   0.0000  8.0000       1     456
GRID      306       1  1.7500  15.0000  8.0000       1     456
GRID      307       1  1.7500  45.0000  8.0000       1     456
GRID      308       1  1.7500  75.0000  8.0000       1     456
```

```
GRID      309       1  1.7500105.0000   8.0000       1     456
GRID      310       1  1.7500135.0000   8.0000       1     456
GRID      311       1  1.7500165.0000   8.0000       1     456
GRID      312       1  1.7500180.0000   8.0000       1     456
CWEDGE    260      10     305     297      249     306     298     250
CWEDGE    290      10     306     298      250     307     299     251
CWEDGE    320      10     307     299      251     308     300     252
CWEDGE    350      10     308     300      252     309     301     253
CWEDGE    380      10     309     301      253     310     302     254
CWEDGE    410      10     310     302      254     311     303     255
CWEDGE    440      10     311     303      255     312     304     256
CWEDGE    261      10     249     257      305     250     258     306
CWEDGE    291      10     250     258      306     251     259     307
CWEDGE    321      10     251     259      307     252     260     308
CWEDGE    351      10     252     260      308     253     261     309
CWEDGE    381      10     253     261      309     254     262     310
CWEDGE    411      10     254     262      310     255     263     311
CWEDGE    441      10     255     263      311     256     264     312
GRID      313       1  2.0000   0.0000   4.0000       1     456
GRID      314       1  2.0000  15.0000   4.0000       1     456
GRID      315       1  2.0000  45.0000   4.0000       1     456
GRID      316       1  2.0000  75.0000   4.0000       1     456
GRID      317       1  2.0000105.0000   4.0000       1     456
GRID      318       1  2.0000135.0000   4.0000       1     456
GRID      319       1  2.0000165.0000   4.0000       1     456
GRID      320       1  2.0000180.0000   4.0000       1     456
GRID      321       1  2.0000   0.0000   4.8000       1     456
GRID      322       1  2.0000  15.0000   4.8000       1     456
GRID      323       1  2.0000  45.0000   4.8000       1     456
GRID      324       1  2.0000  75.0000   4.8000       1     456
GRID      325       1  2.0000105.0000   4.8000       1     456
GRID      326       1  2.0000135.0000   4.8000       1     456
GRID      327       1  2.0000165.0000   4.8000       1     456
GRID      328       1  2.0000180.0000   4.8000       1     456
CWEDGE    262      10     321     313      265     322     314     266
CWEDGE    292      10     322     314      266     323     315     267
CWEDGE    322      10     323     315      267     324     316     268
CWEDGE    352      10     324     316      268     325     317     269
CWEDGE    382      10     325     317      269     326     318     270
CWEDGE    412      10     326     318      270     327     319     271
CWEDGE    442      10     327     319      271     328     320     272
CWEDGE    263      10     265     273      321     266     274     322
CWEDGE    293      10     266     274      322     267     275     323
CWEDGE    323      10     267     275      323     268     276     324
CWEDGE    353      10     268     276      324     269     277     325
CWEDGE    383      10     269     277      325     270     278     326
CWEDGE    413      10     270     278      326     271     279     327
CWEDGE    443      10     271     279      327     272     280     328
GRID      329       1  2.0000   0.0000   5.6000       1     456
GRID      330       1  2.0000  15.0000   5.6000       1     456
GRID      331       1  2.0000  45.0000   5.6000       1     456
GRID      332       1  2.0000  75.0000   5.6000       1     456
GRID      333       1  2.0000105.0000   5.6000       1     456
GRID      334       1  2.0000135.0000   5.6000       1     456
GRID      335       1  2.0000165.0000   5.6000       1     456
GRID      336       1  2.0000180.0000   5.6000       1     456
CWEDGE    264      10     329     321      273     330     322     274
CWEDGE    294      10     330     322      274     331     323     275
CWEDGE    324      10     331     323      275     332     324     276
CWEDGE    354      10     332     324      276     333     325     277
CWEDGE    384      10     333     325      277     334     326     278
CWEDGE    414      10     334     326      278     335     327     279
CWEDGE    444      10     335     327      279     336     328     280
CWEDGE    265      10     273     281      329     274     282     330
```

```
CWEDGE   295     10      274     282     330     275     283     331
CWEDGE   325     10      275     283     331     276     284     332
CWEDGE   355     10      276     284     332     277     285     333
CWEDGE   385     10      277     285     333     278     286     334
CWEDGE   415     10      278     286     334     279     287     335
CWEDGE   445     10      279     287     335     280     288     336
GRID     337     1   2.0000   0.0000  6.4000     1       456
GRID     338     1   2.0000  15.0000  6.4000     1       456
GRID     339     1   2.0000  45.0000  6.4000     1       456
GRID     340     1   2.0000  75.0000  6.4000     1       456
GRID     341     1   2.0000 105.0000  6.4000     1       456
GRID     342     1   2.0000 135.0000  6.4000     1       456
GRID     343     1   2.0000 165.0000  6.4000     1       456
GRID     344     1   2.0000 180.0000  6.4000     1       456
CWEDGE   266     10      337     329     281     338     330     282
CWEDGE   296     10      338     330     282     339     331     283
CWEDGE   326     10      339     331     283     340     332     284
CWEDGE   356     10      340     332     284     341     333     285
CWEDGE   386     10      341     333     285     342     334     286
CWEDGE   416     10      342     334     286     343     335     287
CWEDGE   446     10      343     335     287     344     336     288
CWEDGE   267     10      281     289     337     282     290     338
CWEDGE   297     10      282     290     338     283     291     339
CWEDGE   327     10      283     291     339     284     292     340
CWEDGE   357     10      284     292     340     285     293     341
CWEDGE   387     10      285     293     341     286     294     342
CWEDGE   417     10      286     294     342     287     295     343
CWEDGE   447     10      287     295     343     288     296     344
GRID     345     1   2.0000   0.0000  7.2000     1       456
GRID     346     1   2.0000  15.0000  7.2000     1       456
GRID     347     1   2.0000  45.0000  7.2000     1       456
GRID     348     1   2.0000  75.0000  7.2000     1       456
GRID     349     1   2.0000 105.0000  7.2000     1       456
GRID     350     1   2.0000 135.0000  7.2000     1       456
GRID     351     1   2.0000 165.0000  7.2000     1       456
GRID     352     1   2.0000 180.0000  7.2000     1       456
CWEDGE   268     10      345     337     289     346     338     290
CWEDGE   298     10      346     338     290     347     339     291
CWEDGE   328     10      347     339     291     348     340     292
CWEDGE   358     10      348     340     292     349     341     293
CWEDGE   388     10      349     341     293     350     342     294
CWEDGE   418     10      350     342     294     351     343     295
CWEDGE   448     10      351     343     295     352     344     296
CWEDGE   269     10      289     297     345     290     298     346
CWEDGE   299     10      290     298     346     291     299     347
CWEDGE   329     10      291     299     347     292     300     348
CWEDGE   359     10      292     300     348     293     301     349
CWEDGE   389     10      293     301     349     294     302     350
CWEDGE   419     10      294     302     350     295     303     351
CWEDGE   449     10      295     303     351     296     304     352
GRID     353     1   2.0000   0.0000  8.0000     1       456
GRID     354     1   2.0000  15.0000  8.0000     1       456
GRID     355     1   2.0000  45.0000  8.0000     1       456
GRID     356     1   2.0000  75.0000  8.0000     1       456
GRID     357     1   2.0000 105.0000  8.0000     1       456
GRID     358     1   2.0000 135.0000  8.0000     1       456
GRID     359     1   2.0000 165.0000  8.0000     1       456
GRID     360     1   2.0000 180.0000  8.0000     1       456
CWEDGE   270     10      353     345     297     354     346     298
CWEDGE   300     10      354     346     298     355     347     299
CWEDGE   330     10      355     347     299     356     348     300
CWEDGE   360     10      356     348     300     357     349     301
CWEDGE   390     10      357     349     301     358     350     302
CWEDGE   420     10      358     350     302     359     351     303
```

CWEDGE	450	10	359	351	303	360	352	304
CWEDGE	271	10	297	305	353	298	306	354
CWEDGE	301	10	298	306	354	299	307	355
CWEDGE	331	10	299	307	355	300	308	356
CWEDGE	361	10	300	308	356	301	309	357
CWEDGE	391	10	301	309	357	302	310	358
CWEDGE	421	10	302	310	358	303	311	359
CWEDGE	451	10	303	311	359	304	312	360

PROBLEM B-III

REPEATED SECTION

The following problem demonstrates the JIG repeated section option. Figure B-26 shows the planned finite element model and configuration of one half of a threaded joint. This model consists of two sections. The first represents the skin, the second the threads. Since the threads of this model have a consistant geometry and spacing only the first need be input. A complete listing of the data input is shown in Figure B-27. Figures B-28 and B-29 show the grid point and element numbers as generated by JIG. Figure B-30 gives a NASTRAN structural plot and is followed by a listing of the JIG punched output.

SAMPLE 3

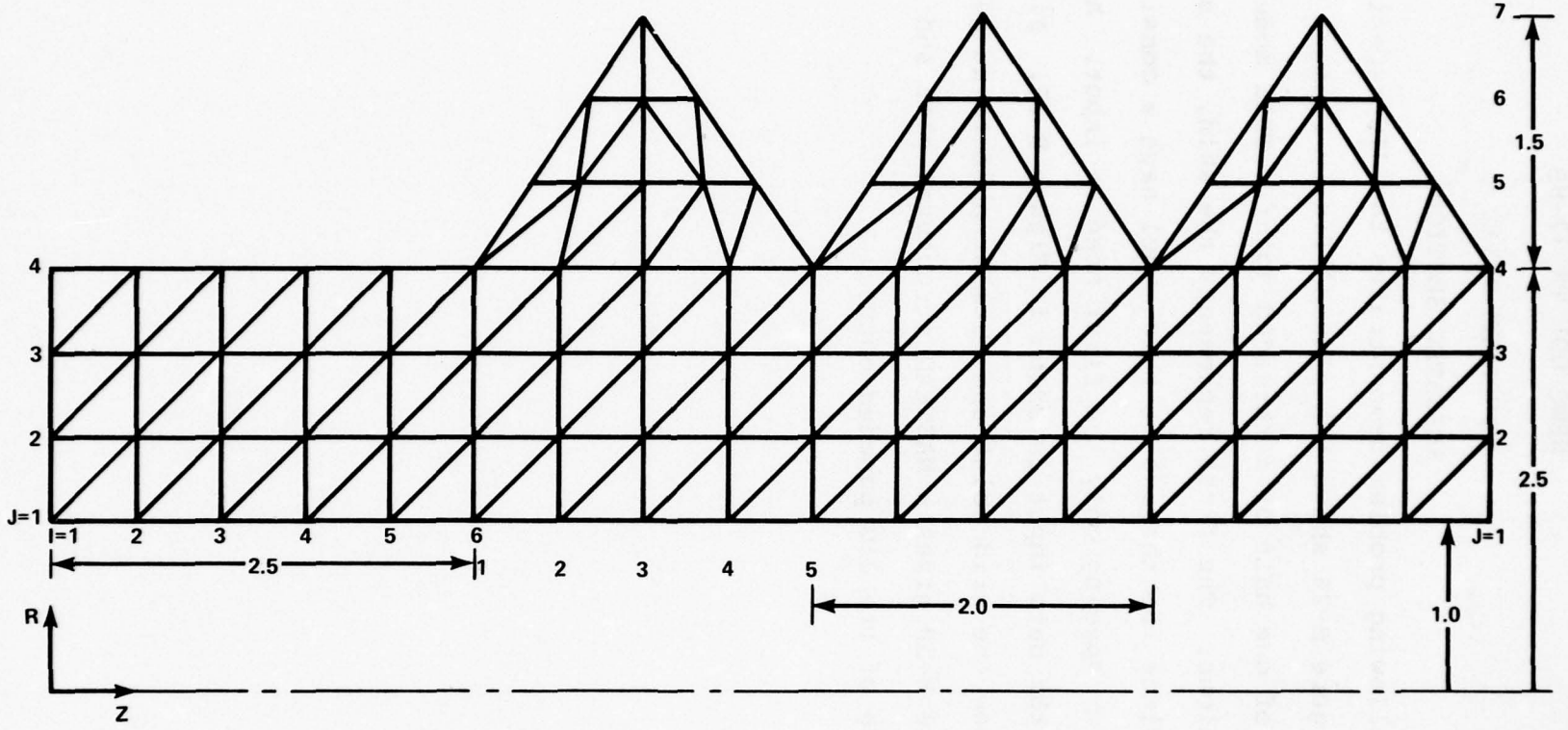


FIG. B-26 PLANNED FINITE ELEMENT MODEL AND CONFIGURATION OF ONE HALF OF A THREADED JOINT.

```
*** SAMPLE 3 - REPEATED SECTION TYPE ***
   2     1     1     1     5     0     0     1
   1     3
  0.0          2.0
   4     1     4     1     6     0     0     0     1     4  450      0
   1     1   0.0           1.0           1     6     1     2.5           1.0          1
   6     4   2.5           2.5           1     1     4     0.0           2.5          1
   6     1     6     1     5     0     1     1     1     4  450      0
   7     3.5         4.0
   1     1   2.5           1.0           1     5     1     4.5           1.0          1
   5     4   4.5           2.5           1     5     6     3.8333        3.5          1
   1     6   3.1667        3.5           1     1     4     2.5           2.5          1
   0
   6     1
```

FIG. B-27 DATA INPUT PROBLEM B-III REPEATED SECTION

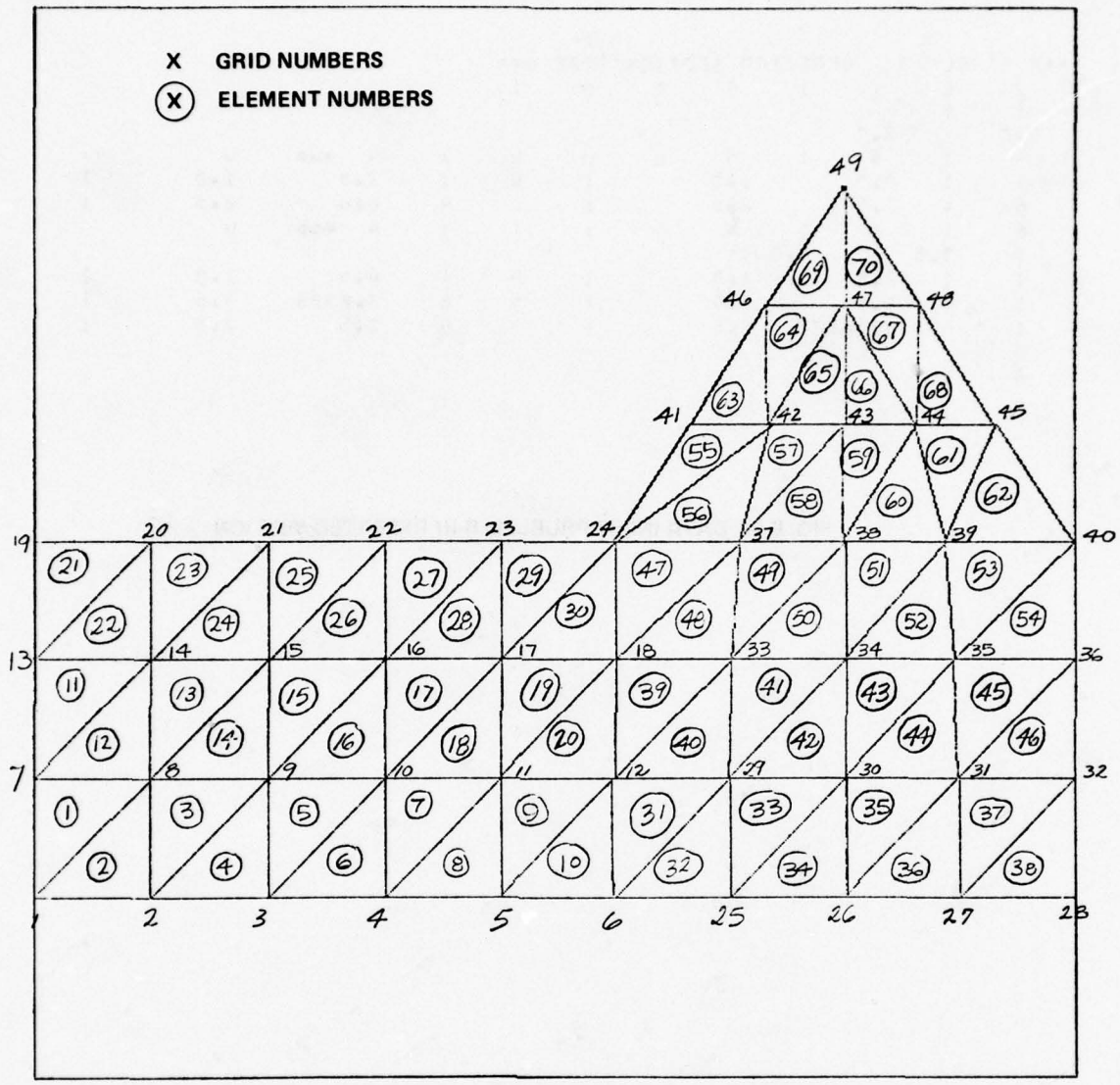


FIG. B-28 GRID POINT AND ELEMENT NUMBERS

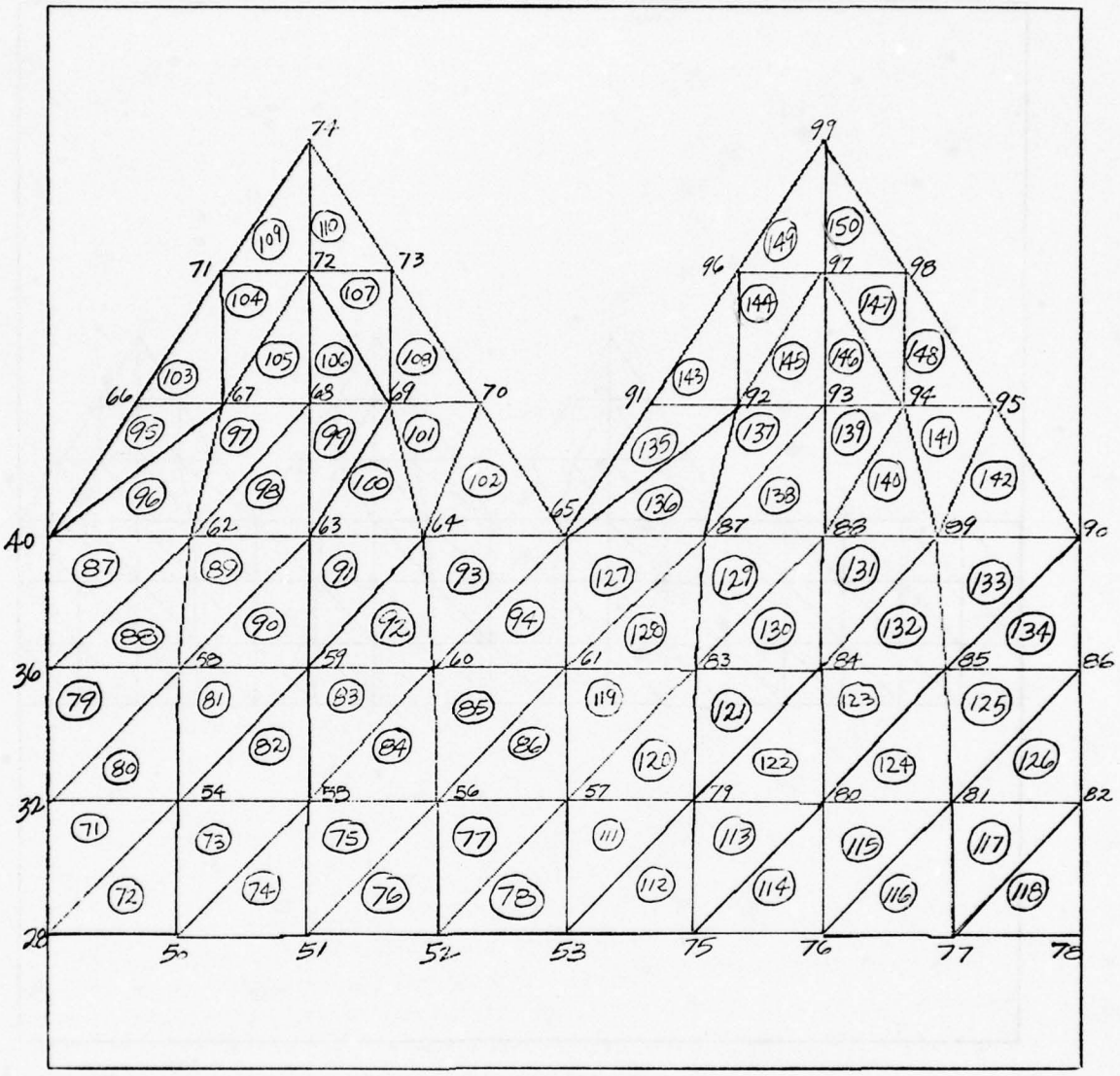


FIG. B-29 GRID POINT AND ELEMENT NUMBERS

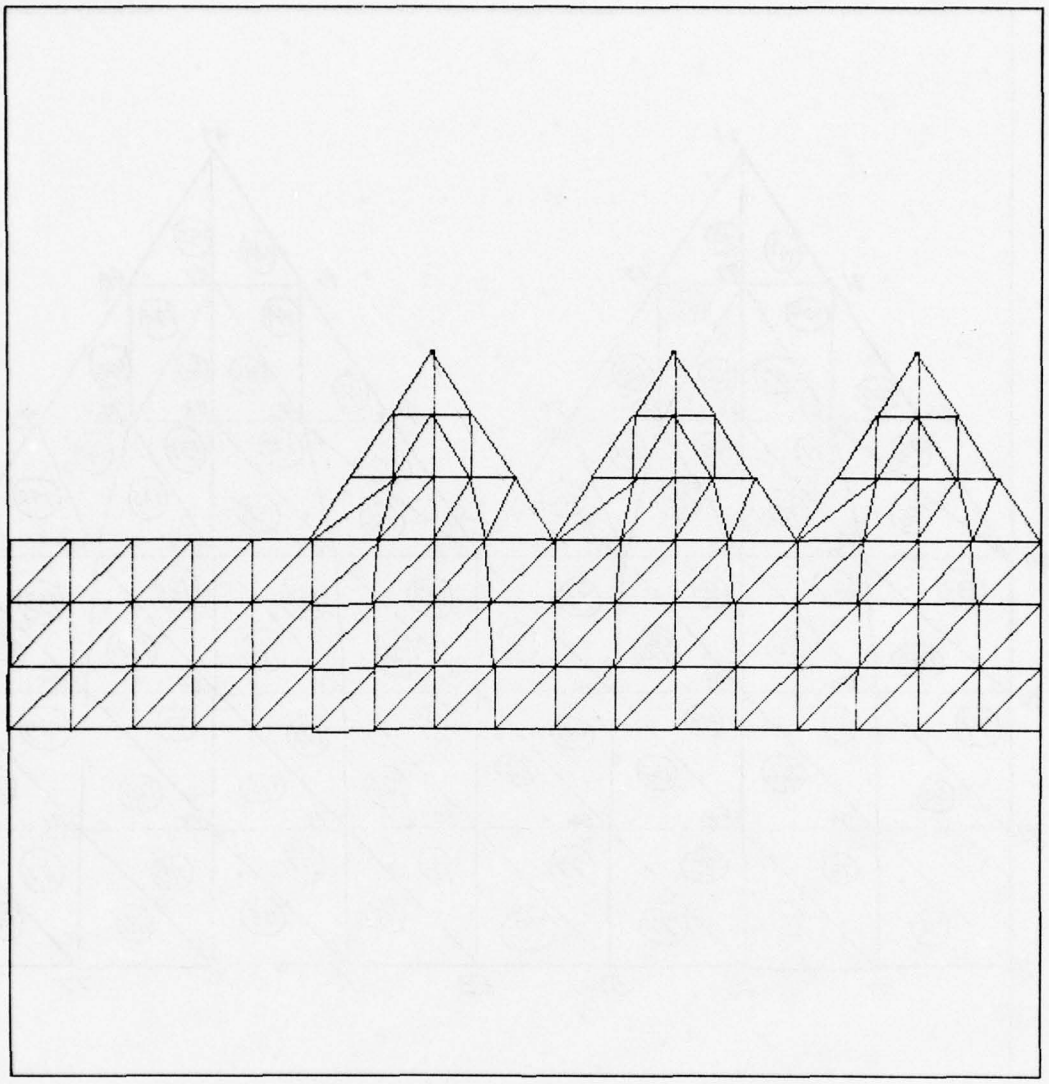


FIG. B-30 NASTRAN STRUCTURAL PLOT

LISTING OF PUNCHED NASTRAN BULK DATA CARDS
PROBLEM B-III REPEATED SECTION

```
**********************************************
**********************************************
**                                          **
**   JUNCTION INPUT GENERATOR PROGRAM  (JIG)  **
**                                          **
**********************************************
**********************************************
```

*** SAMPLE 3 - REPEATED SECTION TYPE ***

```
NST =      2
NGS =      1
NES =      1
NPOP =     1
MID =      5
NGP =      0
IOELT =    0
NSECT =    1
NT( 1) =     1     DELTZ( 1) =     0.0000
NT( 2) =     3     DELTZ( 2) =     2.0000
```

I	J	Z(I,J)	X(I,J)	CODE(I,J)
1	1	0.00000	1.00000	1
2	1	.50000	1.00000	1
3	1	1.00000	1.00000	1
4	1	1.50000	1.00000	1
5	1	2.00000	1.00000	1
6	1	2.50000	1.00000	1
1	2	0.00000	1.50000	1
2	2	.49999	1.49999	0
3	2	1.00000	1.50000	0
4	2	1.49999	1.50000	0
5	2	2.00001	1.50001	0
6	2	2.50000	1.50000	1
1	3	0.00000	2.00000	1
2	3	.50000	2.00000	0
3	3	1.00000	2.00001	0
4	3	1.50001	2.00001	0
5	3	2.00001	2.00001	0
6	3	2.50000	2.00000	1
1	4	0.00000	2.50000	1
2	4	.50000	2.50000	1
3	4	1.00000	2.50000	1
4	4	1.50000	2.50000	1
5	4	2.00000	2.50000	1
6	4	2.50000	2.50000	1

```
GRID          1       0  1.0000   0.0000   0.0000        0      456
GRID          2       0  1.0000   0.0000    .5000        0      456
GRID          3       0  1.0000   0.0000   1.0000        0      456
GRID          4       0  1.0000   0.0000   1.5000        0      456
GRID          5       0  1.0000   0.0000   2.0000        0      456
GRID          6       0  1.0000   0.0000   2.5000        0      456
GRID          7       0  1.5000   0.0000   0.0000        0      456
GRID          8       0  1.5000   0.0000    .5000        0      456
CTRIARG       1       8        7        1  0.0000        5
CTRIARG       2       1        2        8  0.0000        5
GRID          9       0  1.5000   0.0000   1.0000        0      456
CTRIARG       3       9        8        2  0.0000        5
CTRIARG       4       2        3        9  0.0000        5
GRID         10       0  1.5000   0.0000   1.5000        0      456
CTRIARG       5      10        9        3  0.0000        5
CTRIARG       6       3        4       10  0.0000        5
GRID         11       0  1.5000   0.0000   2.0000        0      456
CTRIARG       7      11       10        4  0.0000        5
CTRIARG       8       4        5       11  0.0000        5
GRID         12       0  1.5000   0.0000   2.5000        0      456
CTRIARG       9      12       11        5  0.0000        5
CTRIARG      10       5        6       12  0.0000        5
GRID         13       0  2.0000   0.0000   0.0000        0      456
GRID         14       0  2.0000   0.0000    .5000        0      456
CTRIARG      11      14       13        7  0.0000        5
CTRIARG      12       7        8       14  0.0000        5
GRID         15       0  2.0000   0.0000   1.0000        0      456
CTRIARG      13      15       14        8  0.0000        5
CTRIARG      14       8        9       15  0.0000        5
GRID         16       0  2.0000   0.0000   1.5000        0      456
CTRIARG      15      16       15        9  0.0000        5
CTRIARG      16       9       10       16  0.0000        5
GRID         17       0  2.0000   0.0000   2.0000        0      456
CTRIARG      17      17       16       10  0.0000        5
```

```
CTRIARG      18      10      11      17   0.0000      5
GRID         18       0 2.0000  0.0000   2.5000      0     456
CTRIARG      19      18      17      11   0.0000      5
CTRIARG      20      11      12      18   0.0000      5
GRID         19       0 2.5000  0.0000   0.0000      0     456
GRID         20       0 2.5000  0.0000    .5000      0     456
CTRIARG      21      20      19      13   0.0000      5
CTRIARG      22      13      14      20   0.0000      5
GRID         21       0 2.5000  0.0000   1.0000      0     456
CTRIARG      23      21      20      14   0.0000      5
CTRIARG      24      14      15      21   0.0000      5
GRID         22       0 2.5000  0.0000   1.5000      0     456
CTRIARG      25      22      21      15   0.0000      5
CTRIARG      26      15      16      22   0.0000      5
GRID         23       0 2.5000  0.0000   2.0000      0     456
CTRIARG      27      23      22      16   0.0000      5
CTRIARG      28      16      17      23   0.0000      5
GRID         24       0 2.5000  0.0000   2.5000      0     456
CTRIARG      29      24      23      17   0.0000      5
CTRIARG      30      17      18      24   0.0000      5
```

I	J	Z(I,J)	X(I,J)	CODE(I,J)
1	1	2.50000	1.00000	1
2	1	3.00000	1.00000	1
3	1	3.50000	1.00000	1
4	1	4.00000	1.00000	1
5	1	4.50000	1.00000	1
1	2	2.50000	1.50000	1
2	2	3.00316	1.49998	0
3	2	3.49999	1.49999	0
4	2	3.99679	1.49998	0
5	2	4.50000	1.50000	1
1	3	2.50000	2.00000	1
2	3	3.01274	1.99998	0
3	3	3.49998	1.99999	0
4	3	3.98724	2.00000	0
5	3	4.50000	2.00000	1
1	4	2.50000	2.50000	1
2	4	3.04785	2.50000	0
3	4	3.50004	2.50003	0
4	4	3.95217	2.50002	0
5	4	4.50000	2.50000	1
1	5	2.83335	3.00000	1
2	5	3.17863	2.99999	0
3	5	3.50002	3.00001	0
4	5	3.82133	2.99998	0
5	5	4.16665	3.00000	1
1	6	3.16670	3.50000	1
2	6	3.33335	3.50000	1
3	6	3.50000	3.50000	1
4	6	3.66665	3.50000	1
5	6	3.83330	3.50000	1
1	7	3.50000	4.00000	1

```
GRID         25       0 1.0000  0.0000   3.0000      0     456
GRID         26       0 1.0000  0.0000   3.5000      0     456
GRID         27       0 1.0000  0.0000   4.0000      0     456
GRID         28       0 1.0000  0.0000   4.5000      0     456
GRID         29       0 1.5000  0.0000   3.0032      0     456
CTRIARG      31      29      12       6   0.0000      5
CTRIARG      32       6      25      29   0.0000      5
GRID         30       0 1.5000  0.0000   3.5000      0     456
```

```
CTRIARG      33      30      29      25   0.0000      5
CTRIARG      34      25      26      30   0.0000      5
GRID         31       0  1.5000  0.0000   3.9968      0     456
CTRIARG      35      31      30      26   0.0000      5
CTRIARG      36      26      27      31   0.0000      5
GRID         32       0  1.5000  0.0000   4.5000      0     456
CTRIARG      37      32      31      27   0.0000      5
CTRIARG      38      27      28      32   0.0000      5
GRID         33       0  2.0000  0.0000   3.0127      0     456
CTRIARG      39      33      18      12   0.0000      5
CTRIARG      40      12      29      33   0.0000      5
GRID         34       0  2.0000  0.0000   3.5000      0     456
CTRIARG      41      34      33      29   0.0000      5
CTRIARG      42      29      30      34   0.0000      5
GRID         35       0  2.0000  0.0000   3.9872      0     456
CTRIARG      43      35      34      30   0.0000      5
CTRIARG      44      30      31      35   0.0000      5
GRID         36       0  2.0000  0.0000   4.5000      0     456
CTRIARG      45      36      35      31   0.0000      5
CTRIARG      46      31      32      36   0.0000      5
GRID         37       0  2.5000  0.0000   3.0478      0     456
CTRIARG      47      37      24      18   0.0000      5
CTRIARG      48      18      33      37   0.0000      5
GRID         38       0  2.5000  0.0000   3.5000      0     456
CTRIARG      49      38      37      33   0.0000      5
CTRIARG      50      33      34      38   0.0000      5
GRID         39       0  2.5000  0.0000   3.9522      0     456
CTRIARG      51      39      38      34   0.0000      5
CTRIARG      52      34      35      39   0.0000      5
GRID         40       0  2.5000  0.0000   4.5000      0     456
CTRIARG      53      40      39      35   0.0000      5
CTRIARG      54      35      36      40   0.0000      5
GRID         41       0  3.0000  0.0000   2.8334      0     456
GRID         42       0  3.0000  0.0000   3.1786      0     456
CTRIARG      55      42      41      24   0.0000      5
CTRIARG      56      24      37      42   0.0000      5
GRID         43       0  3.0000  0.0000   3.5000      0     456
CTRIARG      57      43      42      37   0.0000      5
CTRIARG      58      37      38      43   0.0000      5
GRID         44       0  3.0000  0.0000   3.8213      0     456
CTRIARG      59      44      43      38   0.0000      5
CTRIARG      60      38      39      44   0.0000      5
GRID         45       0  3.0000  0.0000   4.1667      0     456
CTRIARG      61      45      44      39   0.0000      5
CTRIARG      62      39      40      45   0.0000      5
GRID         46       0  3.5000  0.0000   3.1667      0     456
GRID         47       0  3.5000  0.0000   3.5000      0     456
CTRIARG      63      41      42      46   0.0000      5
CTRIARG      64      42      47      46   0.0000      5
CTRIARG      65      42      43      47   0.0000      5
GRID         48       0  3.5000  0.0000   3.8333      0     456
CTRIARG      66      43      44      47   0.0000      5
CTRIARG      67      44      48      47   0.0000      5
CTRIARG      68      44      45      48   0.0000      5
GRID         49       0  4.0000  0.0000   3.5000      0     456
CTRIARG      69      47      49      46   0.0000      5
CTRIARG      70      48      49      47   0.0000      5
```

```
I    J     Z(I,J)        X(I,J)   CODE(I,J)

1    1    4.50000       1.00000      1
2    1    5.00000       1.00000      1
```

```
       3     1      5.50000      1.00000      1
       4     1      6.00000      1.00000      1
       5     1      6.50000      1.00000      1
       1     2      4.50000      1.50000      1
       2     2      5.00316      1.49998      0
       3     2      5.49999      1.49999      0
       4     2      5.99679      1.49998      0
       5     2      6.50000      1.50000      1
       1     3      4.50000      2.00000      1
       2     3      5.01274      1.99998      0
       3     3      5.49998      1.99999      0
       4     3      5.98724      2.00000      0
       5     3      6.50000      2.00000      1
       1     4      4.50000      2.50000      1
       2     4      5.04785      2.50000      0
       3     4      5.50004      2.50003      0
       4     4      5.95217      2.50002      0
       5     4      6.50000      2.50000      1
       1     5      4.83335      3.00000      1
       2     5      5.17863      2.99999      0
       3     5      5.50002      3.00001      0
       4     5      5.82133      2.99998      0
       5     5      6.16665      3.00000      1
       1     6      5.16670      3.50000      1
       2     6      5.33335      3.50000      1
       3     6      5.50000      3.50000      1
       4     6      5.66665      3.50000      1
       5     6      5.83330      3.50000      1
       1     7      5.50000      4.00000      1
GRID           50        0    1.0000   0.0000   5.0000        0       456
GRID           51        0    1.0000   0.0000   5.5000        0       456
GRID           52        0    1.0000   0.0000   6.0000        0       456
GRID           53        0    1.0000   0.0000   6.5000        0       456
GRID           54        0    1.5000   0.0000   5.0032        0       456
CTRIARG        71       54        32        28   0.0000        5
CTRIARG        72       28        50        54   0.0000        5
GRID           55        0    1.5000   0.0000   5.5000        0       456
CTRIARG        73       55        54        50   0.0000        5
CTRIARG        74       50        51        55   0.0000        5
GRID           56        0    1.5000   0.0000   5.9968        0       456
CTRIARG        75       56        55        51   0.0000        5
CTRIARG        76       51        52        56   0.0000        5
GRID           57        0    1.5000   0.0000   6.5000        0       456
CTRIARG        77       57        56        52   0.0000        5
CTRIARG        78       52        53        57   0.0000        5
GRID           58        0    2.0000   0.0000   5.0127        0       456
CTRIARG        79       58        36        32   0.0000        5
CTRIARG        80       32        54        58   0.0000        5
GRID           59        0    2.0000   0.0000   5.5000        0       456
CTRIARG        81       59        58        54   0.0000        5
CTRIARG        82       54        55        59   0.0000        5
GRID           60        0    2.0000   0.0000   5.9872        0       456
CTRIARG        83       60        59        55   0.0000        5
CTRIARG        84       55        56        60   0.0000        5
GRID           61        0    2.0000   0.0000   6.5000        0       456
CTRIARG        85       61        60        56   0.0000        5
CTRIARG        86       56        57        61   0.0000        5
GRID           62        0    2.5000   0.0000   5.0478        0       456
CTRIARG        87       62        40        36   0.0000        5
CTRIARG        88       36        58        62   0.0000        5
GRID           63        0    2.5000   0.0000   5.5000        0       456
CTRIARG        89       63        62        58   0.0000        5
CTRIARG        90       58        59        63   0.0000        5
GRID           64        0    2.5000   0.0000   5.9522        0       456
```

CTRIARG	91	64	63	59	0.0000	5	
CTRIARG	92	59	60	64	0.0000	5	
GRID	65	0	2.5000	0.0000	6.5000	0	+56
CTRIARG	93	65	64	60	0.0000	5	
CTRIARG	94	60	61	65	0.0000	5	
GRID	66	0	3.0000	0.0000	4.8334	0	+56
GRID	67	0	3.0000	0.0000	5.1786	0	+56
CTRIARG	95	67	66	40	0.0000	5	
CTRIARG	96	40	62	67	0.0000	5	
GRID	68	0	3.0000	0.0000	5.5000	0	+56
CTRIARG	97	68	67	62	0.0000	5	
CTRIARG	98	62	63	68	0.0000	5	
GRID	69	0	3.0000	0.0000	5.8213	0	+56
CTRIARG	99	69	68	63	0.0000	5	
CTRIARG	100	63	64	69	0.0000	5	
GRID	70	0	3.0000	0.0000	6.1667	0	+56
CTRIARG	101	70	69	64	0.0000	5	
CTRIARG	102	64	65	70	0.0000	5	
GRID	71	0	3.5000	0.0000	5.1667	0	+56
GRID	72	0	3.5000	0.0000	5.5000	0	+56
CTRIARG	103	66	67	71	0.0000	5	
CTRIARG	104	67	72	71	0.0000	5	
CTRIARG	105	67	68	72	0.0000	5	
GRID	73	0	3.5000	0.0000	5.8333	0	+56
CTRIARG	106	68	69	72	0.0000	5	
CTRIARG	107	69	73	72	0.0000	5	
CTRIARG	108	69	70	73	0.0000	5	
GRID	74	0	4.0000	0.0000	5.5000	0	+56
CTRIARG	109	72	74	71	0.0000	5	
CTRIARG	110	73	74	72	0.0000	5	

I	J	Z(I,J)	X(I,J)	CODE(I,J)
1	1	6.50000	1.00000	1
2	1	7.00000	1.00000	1
3	1	7.50000	1.00000	1
4	1	8.00000	1.00000	1
5	1	8.50000	1.00000	1
1	2	6.50000	1.50000	1
2	2	7.00316	1.49998	0
3	2	7.49999	1.49999	0
4	2	7.99679	1.49998	0
5	2	8.50000	1.50000	1
1	3	6.50000	2.00000	1
2	3	7.01274	1.99998	0
3	3	7.49998	1.99999	0
4	3	7.98724	2.00000	0
5	3	8.50000	2.00000	1
1	4	6.50000	2.50000	1
2	4	7.04785	2.50000	0
3	4	7.50004	2.50003	0
4	4	7.95217	2.50002	0
5	4	8.50000	2.50000	1
1	5	6.83335	3.00000	1
2	5	7.17863	2.99999	0
3	5	7.50002	3.00001	0
4	5	7.82133	2.99998	0
5	5	8.16665	3.00000	1
1	6	7.16670	3.50000	1
2	6	7.33335	3.50000	1
3	6	7.50000	3.50000	1
4	6	7.66665	3.50000	1

```
    5     6      7.83330        3.50000        1
    1     7      7.50000        4.00000        1
GRID          75         0  1.0000   0.0000   7.0000         0       456
GRID          76         0  1.0000   0.0000   7.5000         0       456
GRID          77         0  1.0000   0.0000   8.0000         0       456
GRID          78         0  1.0000   0.0000   8.5000         0       456
GRID          79         0  1.5000   0.0000   7.0032         0       456
CTRIARG      111        79       57        53  0.0000         5
CTRIARG      112        53       75        79  0.0000         5
GRID          80         0  1.5000   0.0000   7.5000         0       456
CTRIARG      113        80       79        75  0.0000         5
CTRIARG      114        75       76        80  0.0000         5
GRID          81         0  1.5000   0.0000   7.9968         0       456
CTRIARG      115        81       80        76  0.0000         5
CTRIARG      116        76       77        81  0.0000         5
GRID          82         0  1.5000   0.0000   8.5000         0       456
CTRIARG      117        82       81        77  0.0000         5
CTRIARG      118        77       78        82  0.0000         5
GRID          83         0  2.0000   0.0000   7.0127         0       456
CTRIARG      119        83       61        57  0.0000         5
CTRIARG      120        57       79        83  0.0000         5
GRID          84         0  2.0000   0.0000   7.5000         0       456
CTRIARG      121        84       83        79  0.0000         5
CTRIARG      122        79       80        84  0.0000         5
GRID          85         0  2.0000   0.0000   7.9872         0       456
CTRIARG      123        85       84        80  0.0000         5
CTRIARG      124        80       81        85  0.0000         5
GRID          86         0  2.0000   0.0000   8.5000         0       456
CTRIARG      125        86       85        81  0.0000         5
CTRIARG      126        81       82        86  0.0000         5
GRID          87         0  2.5000   0.0000   7.0478         0       456
CTRIARG      127        87       65        61  0.0000         5
CTRIARG      128        61       83        87  0.0000         5
GRID          88         0  2.5000   0.0000   7.5000         0       456
CTRIARG      129        88       87        83  0.0000         5
CTRIARG      130        83       84        88  0.0000         5
GRID          89         0  2.5000   0.0000   7.9522         0       456
CTRIARG      131        89       88        84  0.0000         5
CTRIARG      132        84       85        89  0.0000         5
GRID          90         0  2.5000   0.0000   8.5000         0       456
CTRIARG      133        90       89        85  0.0000         5
CTRIARG      134        85       86        90  0.0000         5
GRID          91         0  3.0000   0.0000   6.8334         0       456
GRID          92         0  3.0000   0.0000   7.1786         0       456
CTRIARG      135        92       91        65  0.0000         5
CTRIARG      136        65       87        92  0.0000         5
GRID          93         0  3.0000   0.0000   7.5000         0       456
CTRIARG      137        93       92        87  0.0000         5
CTRIARG      138        87       88        93  0.0000         5
GRID          94         0  3.0000   0.0000   7.8213         0       456
CTRIARG      139        94       93        88  0.0000         5
CTRIARG      140        88       89        94  0.0000         5
GRID          95         0  3.0000   0.0000   8.1667         0       456
CTRIARG      141        95       94        89  0.0000         5
CTRIARG      142        89       90        95  0.0000         5
GRID          96         0  3.5000   0.0000   7.1667         0       456
GRID          97         0  3.5000   0.0000   7.5000         0       456
CTRIARG      143        91       92        96  0.0000         5
CTRIARG      144        92       97        96  0.0000         5
CTRIARG      145        92       93        97  0.0000         5
GRID          98         0  3.5000   0.0000   7.8333         0       456
CTRIARG      146        93       94        97  0.0000         5
CTRIARG      147        94       98        97  0.0000         5
CTRIARG      148        94       95        98  0.0000         5
```

```
GRID            99       0  4.0000  0.0000  7.5000       0      456
CTRIARG        149      97      99      96  0.0000       5
CTRIARG        150      98      99      97  0.0000       5
```

PROBLEM B-IV

VARIABLE THETA

This problem demonstrates the variable theta feature of JIG. Figure B-31 shows the planned finite element model and configuration of a tapered cylindrical shell using the variable theta feature. A complete listing of the data input is shown in Figure B-32. Figure B-33 shows the grid point and element numbers as generated by JIG. Figures B-34 and B-35 give NASTRAN structural plots and are followed by a listing of the JIG punched output.

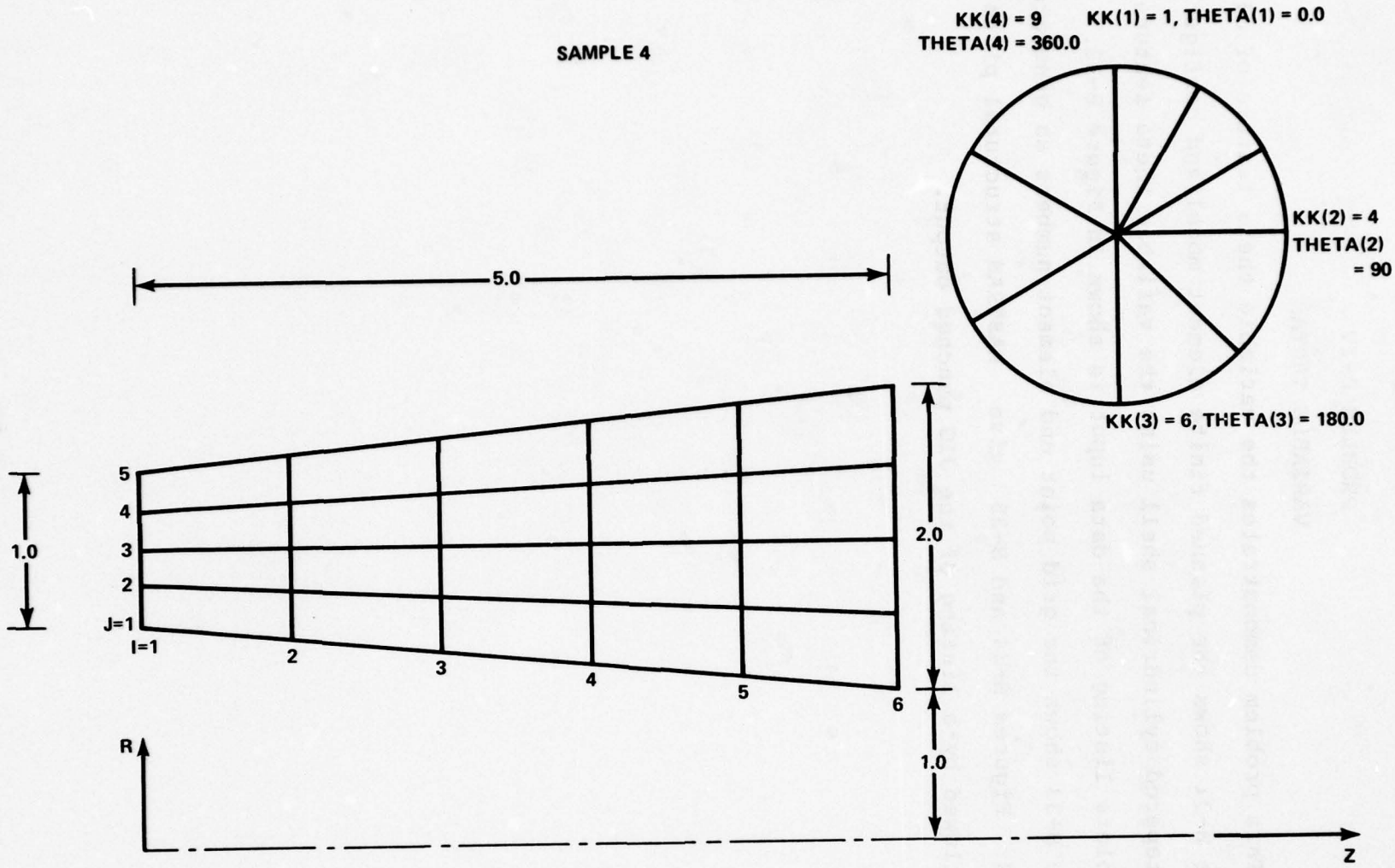


FIG. B-31 PLANNED FINITE ELEMENT MODEL AND CONFIGURATION OF A THICK TAPERED CYLINDRICAL SHELL USING THE VARIABLE THETA FEATURE.

```
*** SAMPLE 4 - VARIABLE THETA ***
   1     1     1     3     5     0     1     1
   1
  0.0
   3     0    50
   1    0.0          4   90.0          6    180.0       9 360.0
  0.0     360.0
   1     5
   4     1     5     1     6     0     0     0     0     0  456     0
   1     1   0.0         1.5           1     6     1    5.0         1.0          1
   6     5   5.0         3.0           1     1     5    0.0         2.5          1
```

FIG. B-32 DATA INPUT PROBLEM B-IV

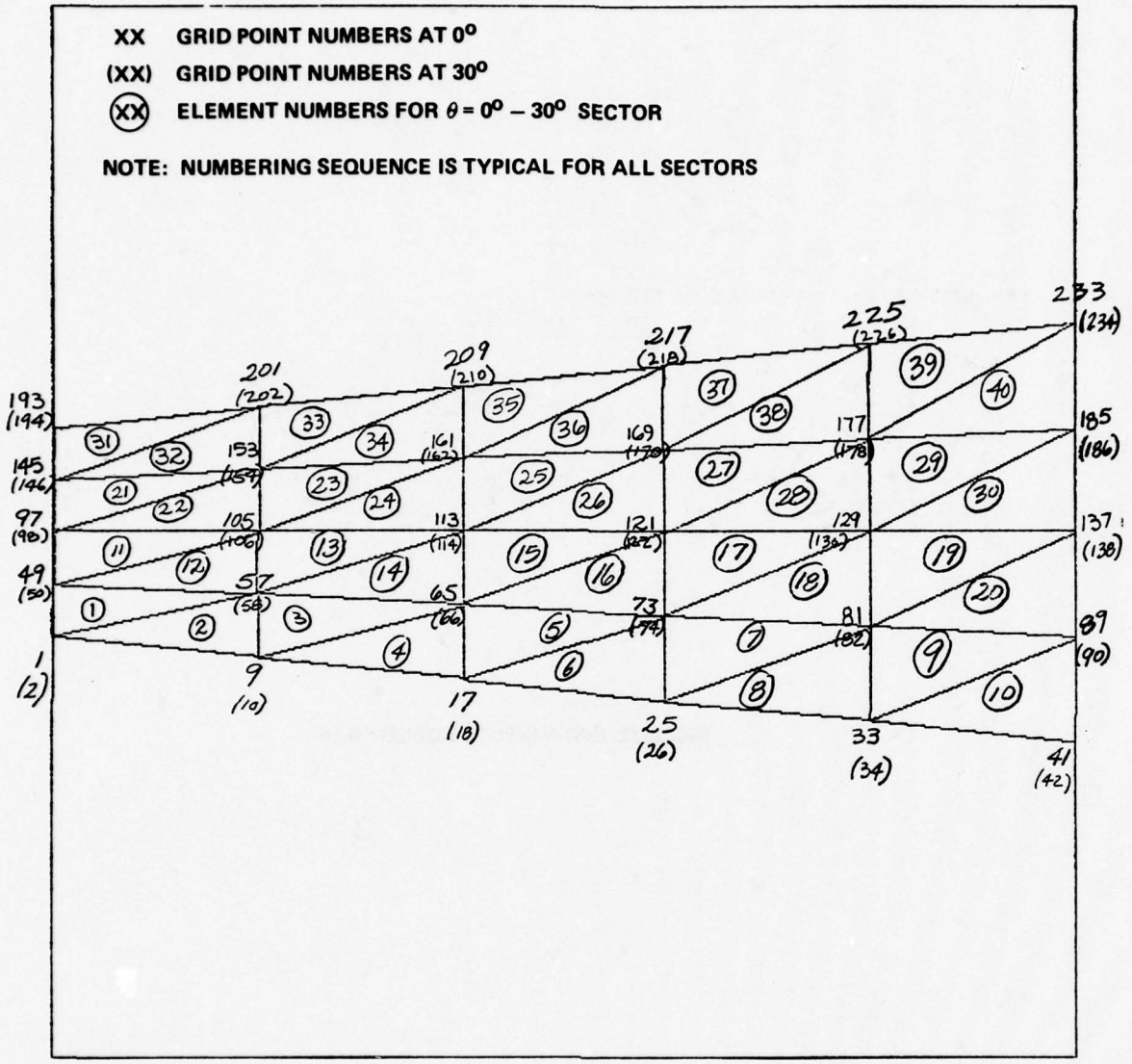


FIG. B-33 GRID POINT AND ELEMENT NUMBERS

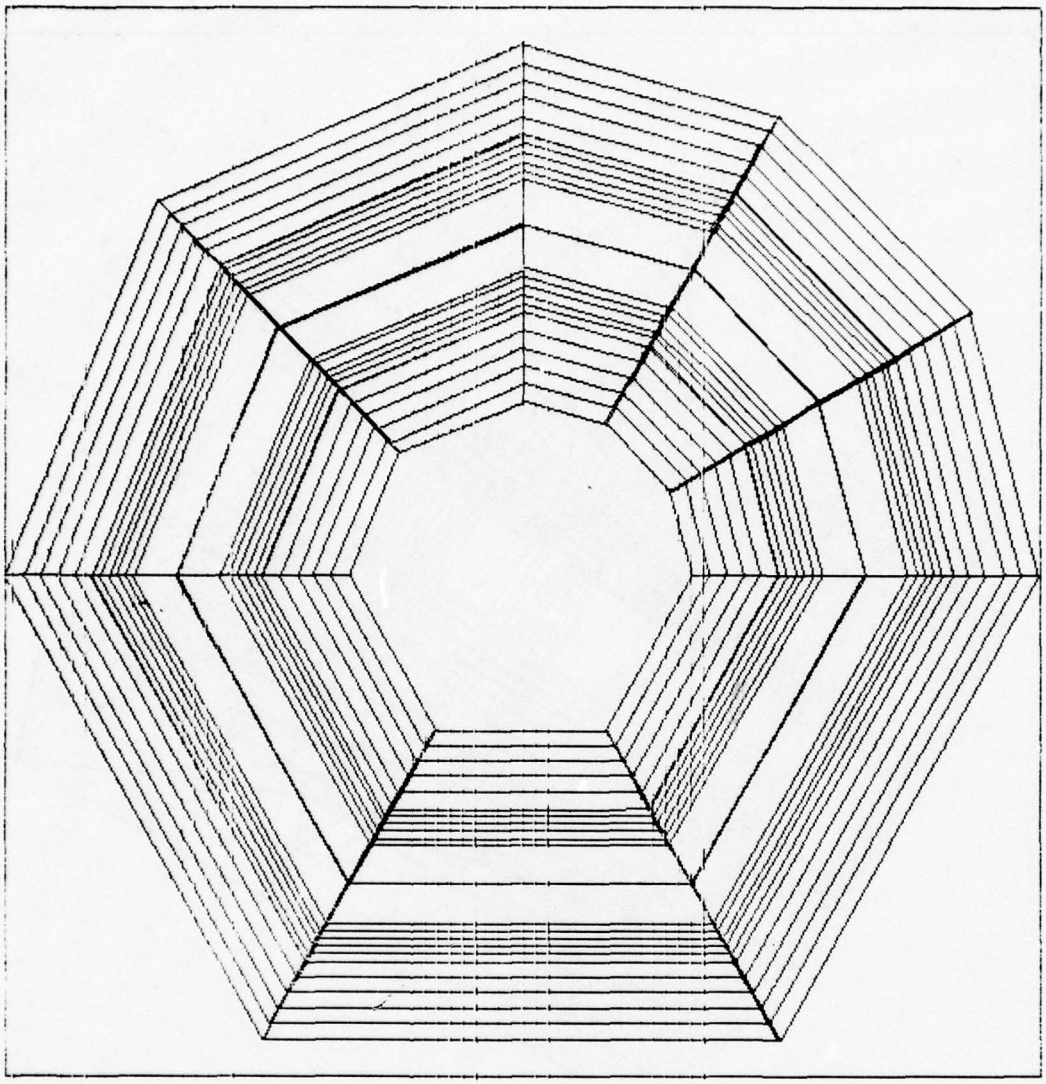


FIG. B-34 NASTRAN STRUCTUAL PLOT. END VIEW

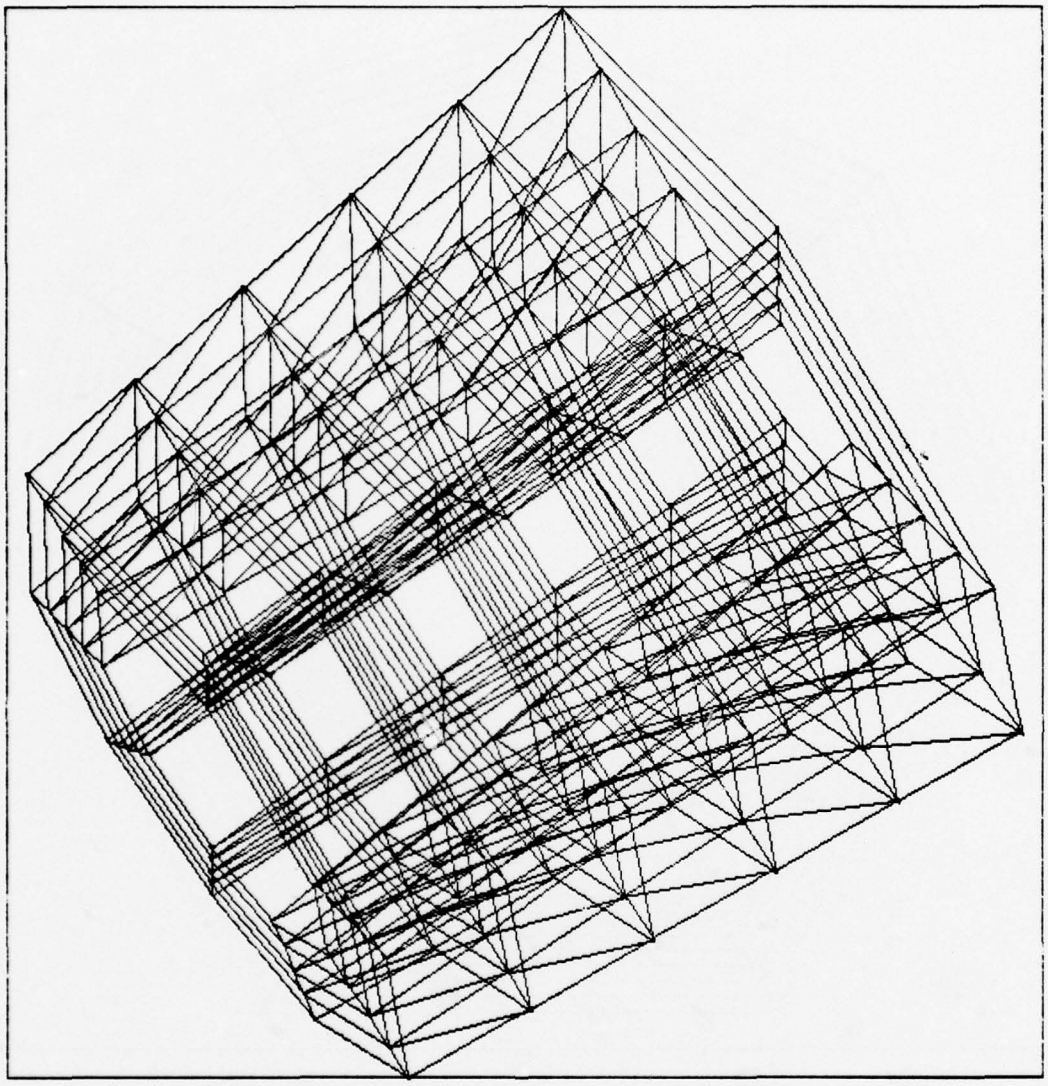


FIG. B-35 NASTRAN STRUCTURAL PLOT. ROTATED VIEW

LISTING OF PUNCHED NASTRAN BULK DATA CARDS
PROBLEM B-IV VARIABLE THETA

```
**********************************************
**********************************************
**                                          **
**   JUNCTION INPUT GENERATOR PROGRAM   (JIG)   **
**                                          **
**********************************************
**********************************************
```

*** SAMPLE 4 - VARIABLE THETA ***

```
NST =      1
NGS =      1
NES =      1
NPOP =     3
MID =      5
NGP =      0
IDELT =    1
NSECT =    1
NT( 1) =     1     DELTZ( 1) =     0.0000
NDT =      3
ICLOSE =   0
DELGP =   50
KK( 1) =     1     THETA( 1) =     0.0000
KK( 2) =     4     THETA( 2) =    90.0000
KK( 3) =     6     THETA( 3) =   180.0000
KK( 4) =     9     THETA( 4) =   360.0000
BETA( 1) =     0.0000
BETA( 2) =   360.0000
JB( 1) =     1     JE( 1) =     5
```

I	J	Z(I,J)	X(I,J)	CODE(I,J)
1	1	0.00000	1.50000	1
2	1	1.00000	1.40000	1
3	1	2.00000	1.30000	1
4	1	3.00000	1.20000	1
5	1	4.00000	1.10000	1
6	1	5.00000	1.00000	1
1	2	0.00000	1.75000	1
2	2	1.00000	1.70000	0
3	2	2.00001	1.65001	0
4	2	3.00002	1.60000	0
5	2	3.99999	1.54999	0
6	2	5.00000	1.50000	1
1	3	0.00000	2.00000	1
2	3	1.00003	2.00002	0
3	3	2.00002	2.00001	0
4	3	3.00000	1.99999	0
5	3	4.00000	2.00000	0
6	3	5.00000	2.00000	1
1	4	0.00000	2.25000	1
2	4	1.00002	2.30001	0
3	4	1.99998	2.34999	0
4	4	3.00000	2.40000	0
5	4	4.00000	2.44999	0
6	4	5.00000	2.50000	1
1	5	0.00000	2.50000	1
2	5	1.00000	2.60000	1
3	5	2.00000	2.70000	1
4	5	3.00000	2.80000	1
5	5	4.00000	2.90000	1
6	5	5.00000	3.00000	1

GRID		1	1	1.5000	0.0000	0.0000	1	456
GRID		2	1	1.5000	30.0000	0.0000	1	456
GRID		3	1	1.5000	60.0000	0.0000	1	456
GRID		4	1	1.5000	90.0000	0.0000	1	456
GRID		5	1	1.5000	135.0000	0.0000	1	456
GRID		6	1	1.5000	180.0000	0.0000	1	456
GRID		7	1	1.5000	240.0000	0.0000	1	456
GRID		8	1	1.5000	300.0000	0.0000	1	456
GRID		9	1	1.4000	0.0000	1.0000	1	456
GRID		10	1	1.4000	30.0000	1.0000	1	456
GRID		11	1	1.4000	60.0000	1.0000	1	456
GRID		12	1	1.4000	90.0000	1.0000	1	456
GRID		13	1	1.4000	135.0000	1.0000	1	456
GRID		14	1	1.4000	180.0000	1.0000	1	456
GRID		15	1	1.4000	240.0000	1.0000	1	456
GRID		16	1	1.4000	300.0000	1.0000	1	456
GRID		17	1	1.3000	0.0000	2.0000	1	456
GRID		18	1	1.3000	30.0000	2.0000	1	456
GRID		19	1	1.3000	60.0000	2.0000	1	456
GRID		20	1	1.3000	90.0000	2.0000	1	456
GRID		21	1	1.3000	135.0000	2.0000	1	456
GRID		22	1	1.3000	180.0000	2.0000	1	456
GRID		23	1	1.3000	240.0000	2.0000	1	456
GRID		24	1	1.3000	300.0000	2.0000	1	456
GRID		25	1	1.2000	0.0000	3.0000	1	456
GRID		26	1	1.2000	30.0000	3.0000	1	456
GRID		27	1	1.2000	60.0000	3.0000	1	456
GRID		28	1	1.2000	90.0000	3.0000	1	456

```
GRID           29       1  1.2000135.0000  3.0000       1      456
GRID           30       1  1.2000180.0000  3.0000       1      456
GRID           31       1  1.2000240.0000  3.0000       1      456
GRID           32       1  1.2000300.0000  3.0000       1      456
GRID           33       1  1.1000   0.0000  4.0000       1      456
GRID           34       1  1.1000  30.0000  4.0000       1      456
GRID           35       1  1.1000  60.0000  4.0000       1      456
GRID           36       1  1.1000  90.0000  4.0000       1      456
GRID           37       1  1.1000135.0000  4.0000       1      456
GRID           38       1  1.1000180.0000  4.0000       1      456
GRID           39       1  1.1000240.0000  4.0000       1      456
GRID           40       1  1.1000300.0000  4.0000       1      456
GRID           41       1  1.0000   0.0000  5.0000       1      456
GRID           42       1  1.0000  30.0000  5.0000       1      456
GRID           43       1  1.0000  60.0000  5.0000       1      456
GRID           44       1  1.0000  90.0000  5.0000       1      456
GRID           45       1  1.0000135.0000  5.0000       1      456
GRID           46       1  1.0000180.0000  5.0000       1      456
GRID           47       1  1.0000240.0000  5.0000       1      456
GRID           48       1  1.0000300.0000  5.0000       1      456
GRID           49       1  1.7500   0.0000  0.0000       1      456
GRID           50       1  1.7500  30.0000  0.0000       1      456
GRID           51       1  1.7500  60.0000  0.0000       1      456
GRID           52       1  1.7500  90.0000  0.0000       1      456
GRID           53       1  1.7500135.0000  0.0000       1      456
GRID           54       1  1.7500180.0000  0.0000       1      456
GRID           55       1  1.7500240.0000  0.0000       1      456
GRID           56       1  1.7500300.0000  0.0000       1      456
GRID           57       1  1.7000   0.0000  1.0000       1      456
GRID           58       1  1.7000  30.0000  1.0000       1      456
GRID           59       1  1.7000  60.0000  1.0000       1      456
GRID           60       1  1.7000  90.0000  1.0000       1      456
GRID           61       1  1.7000135.0000  1.0000       1      456
GRID           62       1  1.7000180.0000  1.0000       1      456
GRID           63       1  1.7000240.0000  1.0000       1      456
GRID           64       1  1.7000300.0000  1.0000       1      456
CWEDGE          1       5      57      49       1      58      50       2
CWEDGE         51       5      58      50       2      59      51       3
CWEDGE        101       5      59      51       3      60      52       4
CWEDGE        151       5      60      52       4      61      53       5
CWEDGE        201       5      61      53       5      62      54       6
CWEDGE        251       5      62      54       6      63      55       7
CWEDGE        301       5      63      55       7      64      56       8
CWEDGE        351       5      64      56       8      57      49       1
CWEDGE          2       5       1       9      57       2      10      58
CWEDGE         52       5       2      10      58       3      11      59
CWEDGE        102       5       3      11      59       4      12      60
CWEDGE        152       5       4      12      60       5      13      61
CWEDGE        202       5       5      13      61       6      14      62
CWEDGE        252       5       6      14      62       7      15      63
CWEDGE        302       5       7      15      63       8      16      64
CWEDGE        352       5       8      16      64       1       9      57
GRID           65       1  1.6500   0.0000  2.0000       1      456
GRID           66       1  1.6500  30.0000  2.0000       1      456
GRID           67       1  1.6500  60.0000  2.0000       1      456
GRID           68       1  1.6500  90.0000  2.0000       1      456
GRID           69       1  1.6500135.0000  2.0000       1      456
GRID           70       1  1.6500180.0000  2.0000       1      456
GRID           71       1  1.6500240.0000  2.0000       1      456
GRID           72       1  1.6500300.0000  2.0000       1      456
CWEDGE          3       5      65      57       9      66      58      10
CWEDGE         53       5      66      58      10      67      59      11
CWEDGE        103       5      67      59      11      68      60      12
CWEDGE        153       5      68      60      12      69      61      13
```

```
CWEDGE   203   5      69      61      13      70      62      14
CWEDGE   253   5      70      62      14      71      63      15
CWEDGE   303   5      71      63      15      72      64      16
CWEDGE   353   5      72      64      16      65      57       9
CWEDGE     4   5       9      17      65      10      18      66
CWEDGE    54   5      10      18      66      11      19      67
CWEDGE   104   5      11      19      67      12      20      68
CWEDGE   154   5      12      20      68      13      21      69
CWEDGE   204   5      13      21      69      14      22      70
CWEDGE   254   5      14      22      70      15      23      71
CWEDGE   304   5      15      23      71      16      24      72
CWEDGE   354   5      16      24      72       9      17      65
GRID      73   1  1.6000   0.0000  3.0000   1     456
GRID      74   1  1.6000  30.0000  3.0000   1     456
GRID      75   1  1.6000  60.0000  3.0000   1     456
GRID      76   1  1.6000  90.0000  3.0000   1     456
GRID      77   1  1.6000 135.0000  3.0000   1     456
GRID      78   1  1.6000 180.0000  3.0000   1     456
GRID      79   1  1.6000 240.0000  3.0000   1     456
GRID      80   1  1.6000 300.0000  3.0000   1     456
CWEDGE     5   5      73      65      17      74      66      18
CWEDGE    55   5      74      66      18      75      67      19
CWEDGE   105   5      75      67      19      76      68      20
CWEDGE   155   5      76      68      20      77      69      21
CWEDGE   205   5      77      69      21      78      70      22
CWEDGE   255   5      78      70      22      79      71      23
CWEDGE   305   5      79      71      23      80      72      24
CWEDGE   355   5      80      72      24      73      65      17
CWEDGE     6   5      17      25      73      18      26      74
CWEDGE    56   5      18      26      74      19      27      75
CWEDGE   106   5      19      27      75      20      28      76
CWEDGE   156   5      20      28      76      21      29      77
CWEDGE   206   5      21      29      77      22      30      78
CWEDGE   256   5      22      30      78      23      31      79
CWEDGE   306   5      23      31      79      24      32      80
CWEDGE   356   5      24      32      80      17      25      73
GRID      81   1  1.5500   0.0000  4.0000   1     456
GRID      82   1  1.5500  30.0000  4.0000   1     456
GRID      83   1  1.5500  60.0000  4.0000   1     456
GRID      84   1  1.5500  90.0000  4.0000   1     456
GRID      85   1  1.5500 135.0000  4.0000   1     456
GRID      86   1  1.5500 180.0000  4.0000   1     456
GRID      87   1  1.5500 240.0000  4.0000   1     456
GRID      88   1  1.5500 300.0000  4.0000   1     456
CWEDGE     7   5      81      73      25      82      74      26
CWEDGE    57   5      82      74      26      83      75      27
CWEDGE   107   5      83      75      27      84      76      28
CWEDGE   157   5      84      76      28      85      77      29
CWEDGE   207   5      85      77      29      86      78      30
CWEDGE   257   5      86      78      30      87      79      31
CWEDGE   307   5      87      79      31      88      80      32
CWEDGE   357   5      88      80      32      81      73      25
CWEDGE     8   5      25      33      81      26      34      82
CWEDGE    58   5      26      34      82      27      35      83
CWEDGE   108   5      27      35      83      28      36      84
CWEDGE   158   5      28      36      84      29      37      85
CWEDGE   208   5      29      37      85      30      38      86
CWEDGE   258   5      30      38      86      31      39      87
CWEDGE   308   5      31      39      87      32      40      88
CWEDGE   358   5      32      40      88      25      33      81
GRID      89   1  1.5000   0.0000  5.0000   1     456
GRID      90   1  1.5000  30.0000  5.0000   1     456
GRID      91   1  1.5000  60.0000  5.0000   1     456
GRID      92   1  1.5000  90.0000  5.0000   1     456
```

```
GRID      93     1  1.5000135.0000  5.0000     1    456
GRID      94     1  1.5000180.0000  5.0000     1    456
GRID      95     1  1.5000240.0000  5.0000     1    456
GRID      96     1  1.5000300.0000  5.0000     1    456
CWEDGE     9     5      89      81      33      90      82      34
CWEDGE    59     5      90      82      34      91      83      35
CWEDGE   109     5      91      83      35      92      84      36
CWEDGE   159     5      92      84      36      93      85      37
CWEDGE   209     5      93      85      37      94      86      38
CWEDGE   259     5      94      86      38      95      87      39
CWEDGE   309     5      95      87      39      96      88      40
CWEDGE   359     5      96      88      40      89      81      33
CWEDGE    10     5      33      41      89      34      42      90
CWEDGE    60     5      34      42      90      35      43      91
CWEDGE   110     5      35      43      91      36      44      92
CWEDGE   160     5      36      44      92      37      45      93
CWEDGE   210     5      37      45      93      38      46      94
CWEDGE   260     5      38      46      94      39      47      95
CWEDGE   310     5      39      47      95      40      48      96
CWEDGE   360     5      40      48      96      33      41      89
GRID      97     1  2.0000   0.0000  0.0000     1    456
GRID      98     1  2.0000  30.0000  0.0000     1    456
GRID      99     1  2.0000  60.0000  0.0000     1    456
GRID     100     1  2.0000  90.0000  0.0000     1    456
GRID     101     1  2.0000135.0000  0.0000     1    456
GRID     102     1  2.0000180.0000  0.0000     1    456
GRID     103     1  2.0000240.0000  0.0000     1    456
GRID     104     1  2.0000300.0000  0.0000     1    456
GRID     105     1  2.0000   0.0000  1.0000     1    456
GRID     106     1  2.0000  30.0000  1.0000     1    456
GRID     107     1  2.0000  60.0000  1.0000     1    456
GRID     108     1  2.0000  90.0000  1.0000     1    456
GRID     109     1  2.0000135.0000  1.0000     1    456
GRID     110     1  2.0000180.0000  1.0000     1    456
GRID     111     1  2.0000240.0000  1.0000     1    456
GRID     112     1  2.0000300.0000  1.0000     1    456
CWEDGE    11     5     105      97      49     106      98      50
CWEDGE    61     5     106      98      50     107      99      51
CWEDGE   111     5     107      99      51     108     100      52
CWEDGE   161     5     108     100      52     109     101      53
CWEDGE   211     5     109     101      53     110     102      54
CWEDGE   261     5     110     102      54     111     103      55
CWEDGE   311     5     111     103      55     112     104      56
CWEDGE   361     5     112     104      56     105      97      49
CWEDGE    12     5      49      57     105      50      58     106
CWEDGE    62     5      50      58     106      51      59     107
CWEDGE   112     5      51      59     107      52      60     108
CWEDGE   162     5      52      60     108      53      61     109
CWEDGE   212     5      53      61     109      54      62     110
CWEDGE   262     5      54      62     110      55      63     111
CWEDGE   312     5      55      63     111      56      64     112
CWEDGE   362     5      56      64     112      49      57     105
GRID     113     1  2.0000   0.0000  2.0000     1    456
GRID     114     1  2.0000  30.0000  2.0000     1    456
GRID     115     1  2.0000  60.0000  2.0000     1    456
GRID     116     1  2.0000  90.0000  2.0000     1    456
GRID     117     1  2.0000135.0000  2.0000     1    456
GRID     118     1  2.0000180.0000  2.0000     1    456
GRID     119     1  2.0000240.0000  2.0000     1    456
GRID     120     1  2.0000300.0000  2.0000     1    456
CWEDGE    13     5     113     105      57     114     106      58
CWEDGE    63     5     114     106      58     115     107      59
CWEDGE   113     5     115     107      59     116     108      60
CWEDGE   163     5     116     108      60     117     109      61
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CWEDGE    213    5     117     109      61     118     110      62
CWEDGE    263    5     118     110      62     119     111      63
CWEDGE    313    5     119     111      63     120     112      64
CWEDGE    363    5     120     112      64     113     105      57
CWEDGE     14    5      57      65     113      58      66     114
CWEDGE     64    5      58      66     114      59      67     115
CWEDGE    114    5      59      67     115      60      68     116
CWEDGE    164    5      60      68     116      61      69     117
CWEDGE    214    5      61      69     117      62      70     118
CWEDGE    264    5      62      70     118      63      71     119
CWEDGE    314    5      63      71     119      64      72     120
CWEDGE    364    5      64      72     120      57      65     113
GRID      121    1  2.0000   0.0000  3.0000       1     456
GRID      122    1  2.0000  30.0000  3.0000       1     456
GRID      123    1  2.0000  60.0000  3.0000       1     456
GRID      124    1  2.0000  90.0000  3.0000       1     456
GRID      125    1  2.0000 135.0000  3.0000       1     456
GRID      126    1  2.0000 180.0000  3.0000       1     456
GRID      127    1  2.0000 240.0000  3.0000       1     456
GRID      128    1  2.0000 300.0000  3.0000       1     456
CWEDGE     15    5     121     113      65     122     114      66
CWEDGE     65    5     122     114      66     123     115      67
CWEDGE    115    5     123     115      67     124     116      68
CWEDGE    165    5     124     116      68     125     117      69
CWEDGE    215    5     125     117      69     126     118      70
CWEDGE    265    5     126     118      70     127     119      71
CWEDGE    315    5     127     119      71     128     120      72
CWEDGE    365    5     128     120      72     121     113      65
CWEDGE     16    5      65      73     121      66      74     122
CWEDGE     66    5      66      74     122      67      75     123
CWEDGE    116    5      67      75     123      68      76     124
CWEDGE    166    5      68      76     124      69      77     125
CWEDGE    216    5      69      77     125      70      78     126
CWEDGE    266    5      70      78     126      71      79     127
CWEDGE    316    5      71      79     127      72      80     128
CWEDGE    366    5      72      80     128      65      73     121
GRID      129    1  2.0000   0.0000  4.0000       1     456
GRID      130    1  2.0000  30.0000  4.0000       1     456
GRID      131    1  2.0000  60.0000  4.0000       1     456
GRID      132    1  2.0000  90.0000  4.0000       1     456
GRID      133    1  2.0000 135.0000  4.0000       1     456
GRID      134    1  2.0000 180.0000  4.0000       1     456
GRID      135    1  2.0000 240.0000  4.0000       1     456
GRID      136    1  2.0000 300.0000  4.0000       1     456
CWEDGE     17    5     129     121      73     130     122      74
CWEDGE     67    5     130     122      74     131     123      75
CWEDGE    117    5     131     123      75     132     124      76
CWEDGE    167    5     132     124      76     133     125      77
CWEDGE    217    5     133     125      77     134     126      78
CWEDGE    267    5     134     126      78     135     127      79
CWEDGE    317    5     135     127      79     136     128      80
CWEDGE    367    5     136     128      80     129     121      73
CWEDGE     18    5      73      81     129      74      82     130
CWEDGE     68    5      74      82     130      75      83     131
CWEDGE    118    5      75      83     131      76      84     132
CWEDGE    168    5      76      84     132      77      85     133
CWEDGE    218    5      77      85     133      78      86     134
CWEDGE    268    5      78      86     134      79      87     135
CWEDGE    318    5      79      87     135      80      88     136
CWEDGE    368    5      80      88     136      73      81     129
GRID      137    1  2.0000   0.0000  5.0000       1     456
GRID      138    1  2.0000  30.0000  5.0000       1     456
GRID      139    1  2.0000  60.0000  5.0000       1     456
GRID      140    1  2.0000  90.0000  5.0000       1     456
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GRID      141       1  2.0000135.0000  5.0000       1     456
GRID      142       1  2.0000180.0000  5.0000       1     456
GRID      143       1  2.0000240.0000  5.0000       1     456
GRID      144       1  2.0000300.0000  5.0000       1     456
CWEDGE     19       5     137     129      81     138     130      82
CWEDGE     69       5     138     130      82     139     131      83
CWEDGE    119       5     139     131      83     140     132      84
CWEDGE    169       5     140     132      84     141     133      85
CWEDGE    219       5     141     133      85     142     134      86
CWEDGE    269       5     142     134      86     143     135      87
CWEDGE    319       5     143     135      87     144     136      88
CWEDGE    369       5     144     136      88     137     129      81
CWEDGE     20       5      81      89     137      82      90     138
CWEDGE     70       5      82      90     138      83      91     139
CWEDGE    120       5      83      91     139      84      92     140
CWEDGE    170       5      84      92     140      85      93     141
CWEDGE    220       5      85      93     141      86      94     142
CWEDGE    270       5      86      94     142      87      95     143
CWEDGE    320       5      87      95     143      88      96     144
CWEDGE    370       5      88      96     144      81      89     137
GRID      145       1  2.2500   0.0000  0.0000       1     456
GRID      146       1  2.2500  30.0000  0.0000       1     456
GRID      147       1  2.2500  60.0000  0.0000       1     456
GRID      148       1  2.2500  90.0000  0.0000       1     456
GRID      149       1  2.2500135.0000  0.0000       1     456
GRID      150       1  2.2500180.0000  0.0000       1     456
GRID      151       1  2.2500240.0000  0.0000       1     456
GRID      152       1  2.2500300.0000  0.0000       1     456
GRID      153       1  2.3000   0.0000  1.0000       1     456
GRID      154       1  2.3000  30.0000  1.0000       1     456
GRID      155       1  2.3000  60.0000  1.0000       1     456
GRID      156       1  2.3000  90.0000  1.0000       1     456
GRID      157       1  2.3000135.0000  1.0000       1     456
GRID      158       1  2.3000180.0000  1.0000       1     456
GRID      159       1  2.3000240.0000  1.0000       1     456
GRID      160       1  2.3000300.0000  1.0000       1     456
CWEDGE     21       5     153     145      97     154     146      98
CWEDGE     71       5     154     146      98     155     147      99
CWEDGE    121       5     155     147      99     156     148     100
CWEDGE    171       5     156     148     100     157     149     101
CWEDGE    221       5     157     149     101     158     150     102
CWEDGE    271       5     158     150     102     159     151     103
CWEDGE    321       5     159     151     103     160     152     104
CWEDGE    371       5     160     152     104     153     145      97
CWEDGE     22       5      97     105     153      98     106     154
CWEDGE     72       5      98     106     154      99     107     155
CWEDGE    122       5      99     107     155     100     108     156
CWEDGE    172       5     100     108     156     101     109     157
CWEDGE    222       5     101     109     157     102     110     158
CWEDGE    272       5     102     110     158     103     111     159
CWEDGE    322       5     103     111     159     104     112     160
CWEDGE    372       5     104     112     160      97     105     153
GRID      161       1  2.3500   0.0000  2.0000       1     456
GRID      162       1  2.3500  30.0000  2.0000       1     456
GRID      163       1  2.3500  60.0000  2.0000       1     456
GRID      164       1  2.3500  90.0000  2.0000       1     456
GRID      165       1  2.3500135.0000  2.0000       1     456
GRID      166       1  2.3500180.0000  2.0000       1     456
GRID      167       1  2.3500240.0000  2.0000       1     456
GRID      168       1  2.3500300.0000  2.0000       1     456
CWEDGE     23       5     161     153     105     162     154     106
CWEDGE     73       5     162     154     106     163     155     107
CWEDGE    123       5     163     155     107     164     156     108
CWEDGE    173       5     164     156     108     165     157     109
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CWEDGE    223     5     165     157     109     166     158     110
CWEDGE    273     5     166     158     110     167     159     111
CWEDGE    323     5     167     159     111     168     160     112
CWEDGE    373     5     168     160     112     161     153     105
CWEDGE     24     5     105     113     161     106     114     162
CWEDGE     74     5     106     114     162     107     115     163
CWEDGE    124     5     107     115     163     108     116     164
CWEDGE    174     5     108     116     164     109     117     165
CWEDGE    224     5     109     117     165     110     118     166
CWEDGE    274     5     110     118     166     111     119     167
CWEDGE    324     5     111     119     167     112     120     168
CWEDGE    374     5     112     120     168     105     113     161
GRID      169     1  2.4000   0.0000  3.0000       1     456
GRID      170     1  2.4000  30.0000  3.0000       1     456
GRID      171     1  2.4000  60.0000  3.0000       1     456
GRID      172     1  2.4000  90.0000  3.0000       1     456
GRID      173     1  2.4000 135.0000  3.0000       1     456
GRID      174     1  2.4000 180.0000  3.0000       1     456
GRID      175     1  2.4000 240.0000  3.0000       1     456
GRID      176     1  2.4000 300.0000  3.0000       1     456
CWEDGE     25     5     169     161     113     170     162     114
CWEDGE     75     5     170     162     114     171     163     115
CWEDGE    125     5     171     163     115     172     164     116
CWEDGE    175     5     172     164     116     173     165     117
CWEDGE    225     5     173     165     117     174     166     118
CWEDGE    275     5     174     166     118     175     167     119
CWEDGE    325     5     175     167     119     176     168     120
CWEDGE    375     5     176     168     120     169     161     113
CWEDGE     26     5     113     121     169     114     122     170
CWEDGE     76     5     114     122     170     115     123     171
CWEDGE    126     5     115     123     171     116     124     172
CWEDGE    176     5     116     124     172     117     125     173
CWEDGE    226     5     117     125     173     118     126     174
CWEDGE    276     5     118     126     174     119     127     175
CWEDGE    326     5     119     127     175     120     128     176
CWEDGE    376     5     120     128     176     113     121     169
GRID      177     1  2.4500   0.0000  4.0000       1     456
GRID      178     1  2.4500  30.0000  4.0000       1     456
GRID      179     1  2.4500  60.0000  4.0000       1     456
GRID      180     1  2.4500  90.0000  4.0000       1     456
GRID      181     1  2.4500 135.0000  4.0000       1     456
GRID      182     1  2.4500 180.0000  4.0000       1     456
GRID      183     1  2.4500 240.0000  4.0000       1     456
GRID      184     1  2.4500 300.0000  4.0000       1     456
CWEDGE     27     5     177     169     121     178     170     122
CWEDGE     77     5     178     170     122     179     171     123
CWEDGE    127     5     179     171     123     180     172     124
CWEDGE    177     5     180     172     124     181     173     125
CWEDGE    227     5     181     173     125     182     174     126
CWEDGE    277     5     182     174     126     183     175     127
CWEDGE    327     5     183     175     127     184     176     128
CWEDGE    377     5     184     176     128     177     169     121
CWEDGE     28     5     121     129     177     122     130     178
CWEDGE     78     5     122     130     178     123     131     179
CWEDGE    128     5     123     131     179     124     132     180
CWEDGE    178     5     124     132     180     125     133     181
CWEDGE    228     5     125     133     181     126     134     182
CWEDGE    278     5     126     134     182     127     135     183
CWEDGE    328     5     127     135     183     128     136     184
CWEDGE    378     5     128     136     184     121     129     177
GRID      185     1  2.5000   0.0000  5.0000       1     456
GRID      186     1  2.5000  30.0000  5.0000       1     456
GRID      187     1  2.5000  60.0000  5.0000       1     456
GRID      188     1  2.5000  90.0000  5.0000       1     456
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GRID      189       1  2.5000135.0000  5.0000       1      456
GRID      190       1  2.5000180.0000  5.0000       1      456
GRID      191       1  2.5000240.0000  5.0000       1      456
GRID      192       1  2.5000300.0000  5.0000       1      456
CWEDGE     29       5     185     177     129     186     178     130
CWEDGE     79       5     186     178     130     187     179     131
CWEDGE    129       5     187     179     131     188     180     132
CWEDGE    179       5     188     180     132     189     181     133
CWEDGE    229       5     189     181     133     190     182     134
CWEDGE    279       5     190     182     134     191     183     135
CWEDGE    329       5     191     183     135     192     184     136
CWEDGE    379       5     192     184     136     185     177     129
CWEDGE     30       5     129     137     185     130     138     186
CWEDGE     80       5     130     138     186     131     139     187
CWEDGE    130       5     131     139     187     132     140     188
CWEDGE    180       5     132     140     188     133     141     189
CWEDGE    230       5     133     141     189     134     142     190
CWEDGE    280       5     134     142     190     135     143     191
CWEDGE    330       5     135     143     191     136     144     192
CWEDGE    380       5     136     144     192     129     137     185
GRID      193       1  2.5000   0.0000  0.0000       1      456
GRID      194       1  2.5000  30.0000  0.0000       1      456
GRID      195       1  2.5000  60.0000  0.0000       1      456
GRID      196       1  2.5000  90.0000  0.0000       1      456
GRID      197       1  2.5000135.0000  0.0000       1      456
GRID      198       1  2.5000180.0000  0.0000       1      456
GRID      199       1  2.5000240.0000  0.0000       1      456
GRID      200       1  2.5000300.0000  0.0000       1      456
GRID      201       1  2.6000   0.0000  1.0000       1      456
GRID      202       1  2.6000  30.0000  1.0000       1      456
GRID      203       1  2.6000  60.0000  1.0000       1      456
GRID      204       1  2.6000  90.0000  1.0000       1      456
GRID      205       1  2.6000135.0000  1.0000       1      456
GRID      206       1  2.6000180.0000  1.0000       1      456
GRID      207       1  2.6000240.0000  1.0000       1      456
GRID      208       1  2.6000300.0000  1.0000       1      456
CWEDGE     31       5     201     193     145     202     194     146
CWEDGE     81       5     202     194     146     203     195     147
CWEDGE    131       5     203     195     147     204     196     148
CWEDGE    181       5     204     196     148     205     197     149
CWEDGE    231       5     205     197     149     206     198     150
CWEDGE    281       5     206     198     150     207     199     151
CWEDGE    331       5     207     199     151     208     200     152
CWEDGE    381       5     208     200     152     201     193     145
CWEDGE     32       5     145     153     201     146     154     202
CWEDGE     82       5     146     154     202     147     155     203
CWEDGE    132       5     147     155     203     148     156     204
CWEDGE    182       5     148     156     204     149     157     205
CWEDGE    232       5     149     157     205     150     158     206
CWEDGE    282       5     150     158     206     151     159     207
CWEDGE    332       5     151     159     207     152     160     208
CWEDGE    382       5     152     160     208     145     153     201
GRID      209       1  2.7000   0.0000  2.0000       1      456
GRID      210       1  2.7000  30.0000  2.0000       1      456
GRID      211       1  2.7000  60.0000  2.0000       1      456
GRID      212       1  2.7000  90.0000  2.0000       1      456
GRID      213       1  2.7000135.0000  2.0000       1      456
GRID      214       1  2.7000180.0000  2.0000       1      456
GRID      215       1  2.7000240.0000  2.0000       1      456
GRID      216       1  2.7000300.0000  2.0000       1      456
CWEDGE     33       5     209     201     153     210     202     154
CWEDGE     83       5     210     202     154     211     203     155
CWEDGE    133       5     211     203     155     212     204     156
CWEDGE    183       5     212     204     156     213     205     157
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CWEDGE    233     5     213     205     157     214     206     158
CWEDGE    283     5     214     206     158     215     207     159
CWEDGE    333     5     215     207     159     216     208     160
CWEDGE    383     5     216     208     160     209     201     153
CWEDGE     34     5     153     161     209     154     162     210
CWEDGE     84     5     154     162     210     155     163     211
CWEDGE    134     5     155     163     211     156     164     212
CWEDGE    184     5     156     164     212     157     165     213
CWEDGE    234     5     157     165     213     158     166     214
CWEDGE    284     5     158     166     214     159     167     215
CWEDGE    334     5     159     167     215     160     168     216
CWEDGE    384     5     160     168     216     153     161     209
GRID      217     1  2.8000   0.0000  3.0000       1     456
GRID      218     1  2.8000  30.0000  3.0000       1     456
GRID      219     1  2.8000  60.0000  3.0000       1     456
GRID      220     1  2.8000  90.0000  3.0000       1     456
GRID      221     1  2.8000 135.0000  3.0000       1     456
GRID      222     1  2.8000 180.0000  3.0000       1     456
GRID      223     1  2.8000 240.0000  3.0000       1     456
GRID      224     1  2.8000 300.0000  3.0000       1     456
CWEDGE     35     5     217     209     161     218     210     162
CWEDGE     85     5     218     210     162     219     211     163
CWEDGE    135     5     219     211     163     220     212     164
CWEDGE    185     5     220     212     164     221     213     165
CWEDGE    235     5     221     213     165     222     214     166
CWEDGE    285     5     222     214     166     223     215     167
CWEDGE    335     5     223     215     167     224     216     168
CWEDGE    385     5     224     216     168     217     209     161
CWEDGE     36     5     161     169     217     162     170     218
CWEDGE     86     5     162     170     218     163     171     219
CWEDGE    136     5     163     171     219     164     172     220
CWEDGE    186     5     164     172     220     165     173     221
CWEDGE    236     5     165     173     221     166     174     222
CWEDGE    286     5     166     174     222     167     175     223
CWEDGE    336     5     167     175     223     168     176     224
CWEDGE    386     5     168     176     224     161     169     217
GRID      225     1  2.9000   0.0000  4.0000       1     456
GRID      226     1  2.9000  30.0000  4.0000       1     456
GRID      227     1  2.9000  60.0000  4.0000       1     456
GRID      228     1  2.9000  90.0000  4.0000       1     456
GRID      229     1  2.9000 135.0000  4.0000       1     456
GRID      230     1  2.9000 180.0000  4.0000       1     456
GRID      231     1  2.9000 240.0000  4.0000       1     456
GRID      232     1  2.9000 300.0000  4.0000       1     456
CWEDGE     37     5     225     217     169     226     218     170
CWEDGE     87     5     226     218     170     227     219     171
CWEDGE    137     5     227     219     171     228     220     172
CWEDGE    187     5     228     220     172     229     221     173
CWEDGE    237     5     229     221     173     230     222     174
CWEDGE    287     5     230     222     174     231     223     175
CWEDGE    337     5     231     223     175     232     224     176
CWEDGE    387     5     232     224     176     225     217     169
CWEDGE     38     5     169     177     225     170     178     226
CWEDGE     88     5     170     178     226     171     179     227
CWEDGE    138     5     171     179     227     172     180     228
CWEDGE    188     5     172     180     228     173     181     229
CWEDGE    238     5     173     181     229     174     182     230
CWEDGE    288     5     174     182     230     175     183     231
CWEDGE    338     5     175     183     231     176     184     232
CWEDGE    388     5     176     184     232     169     177     225
GRID      233     1  3.0000   0.0000  5.0000       1     456
GRID      234     1  3.0000  30.0000  5.0000       1     456
GRID      235     1  3.0000  60.0000  5.0000       1     456
GRID      236     1  3.0000  90.0000  5.0000       1     456
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GRID      237      1  3.0000135.0000  5.0000       1     456
GRID      238      1  3.0000180.0000  5.0000       1     456
GRID      239      1  3.0000240.0000  5.0000       1     456
GRID      240      1  3.0000300.0000  5.0000       1     456
CWEDGE     39      5     233     225     177     234     226     178
CWEDGE     89      5     234     226     178     235     227     179
CWEDGE    139      5     235     227     179     236     228     180
CWEDGE    189      5     236     228     180     237     229     181
CWEDGE    239      5     237     229     181     238     230     182
CWEDGE    289      5     238     230     182     239     231     183
CWEDGE    339      5     239     231     183     240     232     184
CWEDGE    389      5     240     232     184     233     225     177
CWEDGE     40      5     177     185     233     178     186     234
CWEDGE     90      5     178     186     234     179     187     235
CWEDGE    140      5     179     187     235     180     188     236
CWEDGE    190      5     180     188     236     181     189     237
CWEDGE    240      5     181     189     237     182     190     238
CWEDGE    290      5     182     190     238     183     191     239
CWEDGE    340      5     183     191     239     184     192     240
CWEDGE    390      5     184     192     240     177     185     233
```

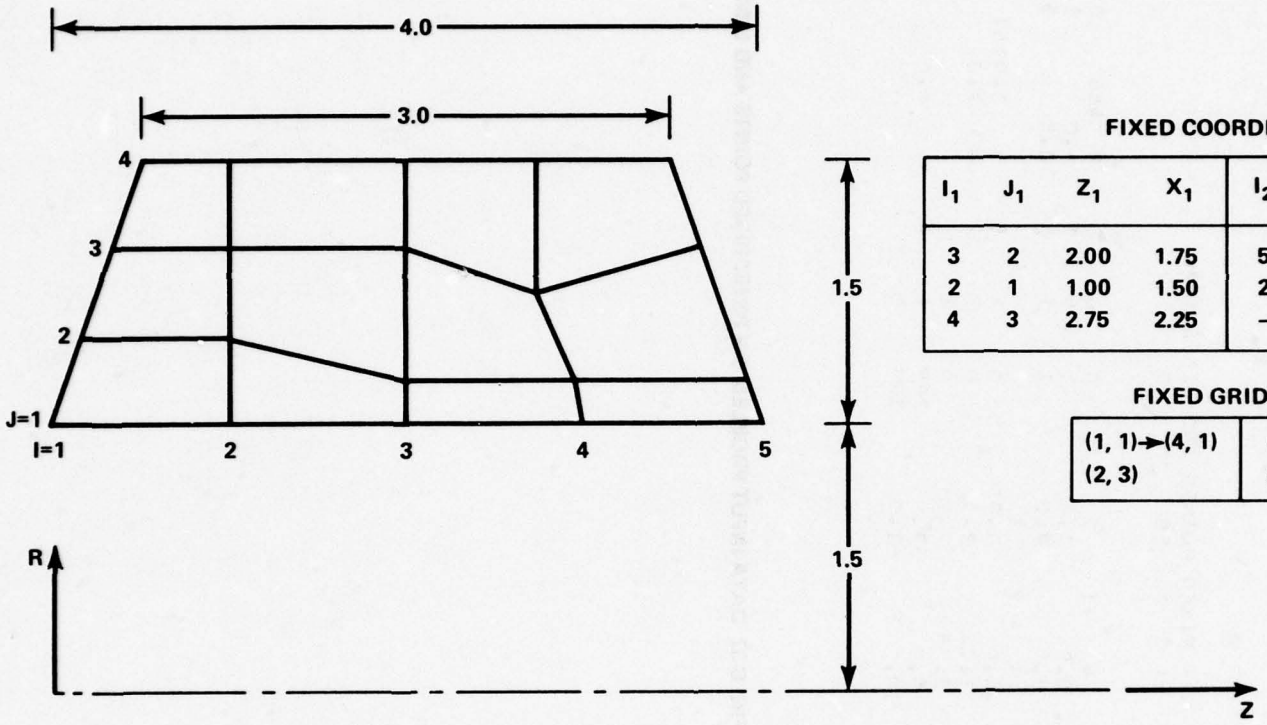
PROBLEM B-V

PRESCRIBED POINTS AND LINES

The following problem demonstrates the application of prescribed points and lines in a solid ring. Figure B-36 shows the planned finite element model and configuration of a solid ring containing both fixed lines and points. Three options are available to the user. The first picking both grid point number and grid coordinate, the second using the program calculated grid coordinate and pinching the grid number, and the third pinching the grid coordinate and using the program calculated grid number. The added feature of having either increasing or decreasing prescribed grid numbers (for lines only) is also included.

A complete listing of the data input is shown in Figure B-37. Figure B-38 shows the grid point and element numbers as generated by JIG. Figure B-39 gives a NASTRAN structural plot and is followed by a listing of the JIG punched output.

SAMPLE 5



FIXED COORDINATES

I_1	J_1	Z_1	X_1	I_2	J_2	Z_2	X_2
3	2	2.00	1.75	5	2	3.9167	1.75
2	1	1.00	1.50	2	4	1.0000	3.00
4	3	2.75	2.25	–	–	–	–

FIXED GRID NO.'S

(1, 1)→(4, 1) (2, 3)	#200 - 203 #300

FIG. B-36 PLANNED FINITE ELEMENT MODEL AND CONFIGURATION OF A SOLID RING CONTAINING BOTH FIXED LINES AND POINTS.

```
*** SAMPLE 5 - FIXED POINTS AND LINES ***
   1     1     1     1    50     0     0     1
   1
  0.0
   4     1     4     1     5     5     0     0     0     0  456     0
   1     1   0.0         1.5           1     5     1   4.0         1.5          1
   5     4   3.5         3.0           1     1     4   0.5         3.0          1
   2     2     1     2     1
   3     2   2.0         1.75          0     1     5     2   3.9167      1.75
   2     1   1.0         1.5           0     1     2     4   1.0         3.0
   4     3  2.75         2.25          0     1
   1     1   0.0        -1.0         200     1     4     1   0.0         0.0
   2     3   0.0        -1.0         300     1
```

FIG. B-37 DATA INPUT PROBLEM B-V PRESCRIBED POINTS AND LINES.

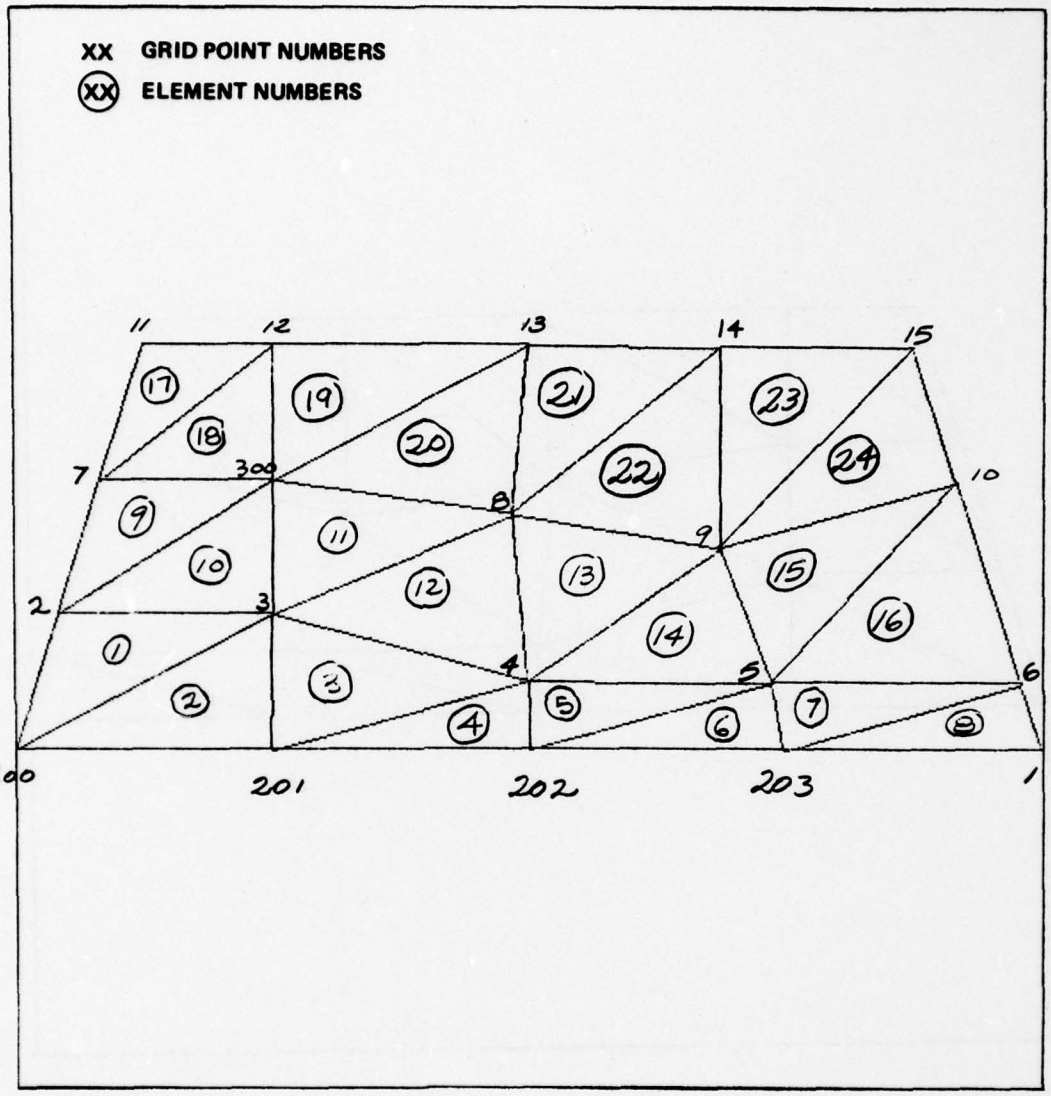


FIG. B-38 GRID POINT AND ELEMENT NUMBERS

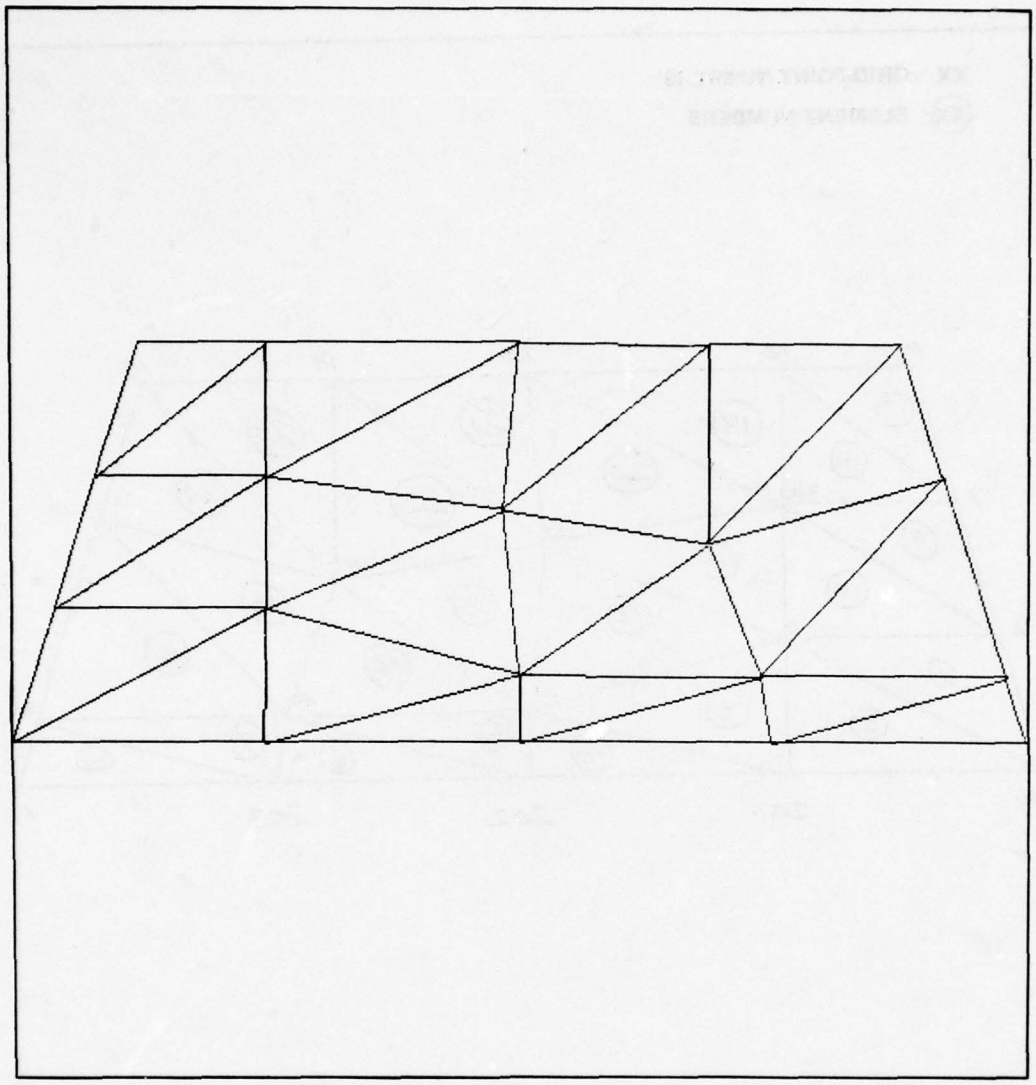


FIG. B-39 NASTRAN STRUCTURAL PLOT

LISTING OF PUNCHED NASTRAN BULK DATA CARDS
PROBLEM B-V PRESCRIBED POINTS AND LINES

```
**************************************************
**************************************************
**                                              **
**   JUNCTION INPUT GENERATOR PROGRAM   (JIG)   **
**                                              **
**************************************************
**************************************************
```

*** SAMPLE 5 - FIXED POINTS AND LINES ***

```
NST =      1
NGS =      1
NES =      1
NPOP =     1
MID =     50
NGP =      0
IDELT =    0
NSECT =    1
NT( 1) =     1     DELTZ( 1) =     0.0000
```

I	J	Z(I,J)	X(I,J)	CODE(I,J)
1	1	0.00000	1.50000	1
2	1	1.00000	1.50000	1
3	1	2.00000	1.50000	1
4	1	3.00000	1.50000	1
5	1	4.00000	1.50000	1
1	2	.16667	2.00000	1
2	2	1.00000	2.00000	2
3	2	2.00000	1.75000	2
4	2	2.95835	1.75000	2
5	2	3.91670	1.75000	1
1	3	.33333	2.50000	1
2	3	1.00000	2.50000	2
3	3	1.93751	2.37502	0
4	3	2.75000	2.25000	2
5	3	3.66667	2.50000	1
1	4	.50000	3.00000	1
2	4	1.00000	3.00000	1
3	4	2.00000	3.00000	1
4	4	2.75000	3.00000	1
5	4	3.50000	3.00000	1

```
GRID          200        0  1.5000  0.0000  0.0000        0      456
GRID          201        0  1.5000  0.0000  1.0000        0      456
GRID          202        0  1.5000  0.0000  2.0000        0      456
GRID          203        0  1.5000  0.0000  3.0000        0      456
GRID            1        0  1.5000  0.0000  4.0000        0      456
GRID            2        0  2.0000  0.0000   .1667        0      456
GRID            3        0  2.0000  0.0000  1.0000        0      456
CTRIARG         1        3       2     200  0.0000       50
CTRIARG         2      200     201       3  0.0000       50
GRID            4        0  1.7500  0.0000  2.0000        0      456
CTRIARG         3        4       3     201  0.0000       50
CTRIARG         4      201     202       4  0.0000       50
GRID            5        0  1.7500  0.0000  2.9584        0      456
CTRIARG         5        5       4     202  0.0000       50
CTRIARG         6      202     203       5  0.0000       50
GRID            6        0  1.7500  0.0000  3.9167        0      456
CTRIARG         7        6       5     203  0.0000       50
CTRIARG         8      203       1       6  0.0000       50
GRID            7        0  2.5000  0.0000   .3333        0      456
GRID          300        0  2.5000  0.0000  1.0000        0      456
CTRIARG         9      300       7       2  0.0000       50
CTRIARG        10        2       3     300  0.0000       50
GRID            8        0  2.3750  0.0000  1.9375        0      456
CTRIARG        11        8     300       3  0.0000       50
CTRIARG        12        3       4       8  0.0000       50
GRID            9        0  2.2500  0.0000  2.7500        0      456
CTRIARG        13        9       8       4  0.0000       50
CTRIARG        14        4       5       9  0.0000       50
GRID           10        0  2.5000  0.0000  3.6667        0      456
CTRIARG        15       10       9       5  0.0000       50
CTRIARG        16        5       6      10  0.0000       50
GRID           11        0  3.0000  0.0000   .5000        0      456
GRID           12        0  3.0000  0.0000  1.0000        0      456
CTRIARG        17       12      11       7  0.0000       50
CTRIARG        18        7     300      12  0.0000       50
GRID           13        0  3.0000  0.0000  2.0000        0      456
CTRIARG        19       13      12     300  0.0000       50
CTRIARG        20      300       8      13  0.0000       50
```

```
GRID      14      0  3.0000  0.0000  2.7500       0      456
CTRIARG   21     14      13       8  0.0000      50
CTRIARG   22      8       9      14  0.0000      50
GRID      15      0  3.0000  0.0000  3.5000       0      456
CTRIARG   23     15      14       9  0.0000      50
CTRIARG   24      9      10      15  0.0000      50
```

PROBLEM B-VI

TRANSITION

The following problem demonstrates the JIG transition options for coarse to fine mesh size or vice versa. Figure B-40 shows the planned finite element model and configuration of a solid cylindrical ring containing coarse to fine then back to coarse regions. The NTNT values must be established at the beginning of a section and at the end of each transition region. The value NTNT is set equal to zero for the finest mesh. Then it is increased by one every time the mesh spacing doubles. Note that at no time can the value of NTNT be less than zero (NTNT $\geq$ 0).

A complete listing of the data input is shown in Figure B-41. Figure B-42 shows the grid point and element identification numbers as generated by JIG. Figure B-43 gives a NASTRAN structural plot of the finite element model and is followed by a listing of the JIG punched output.

SAMPLE 6

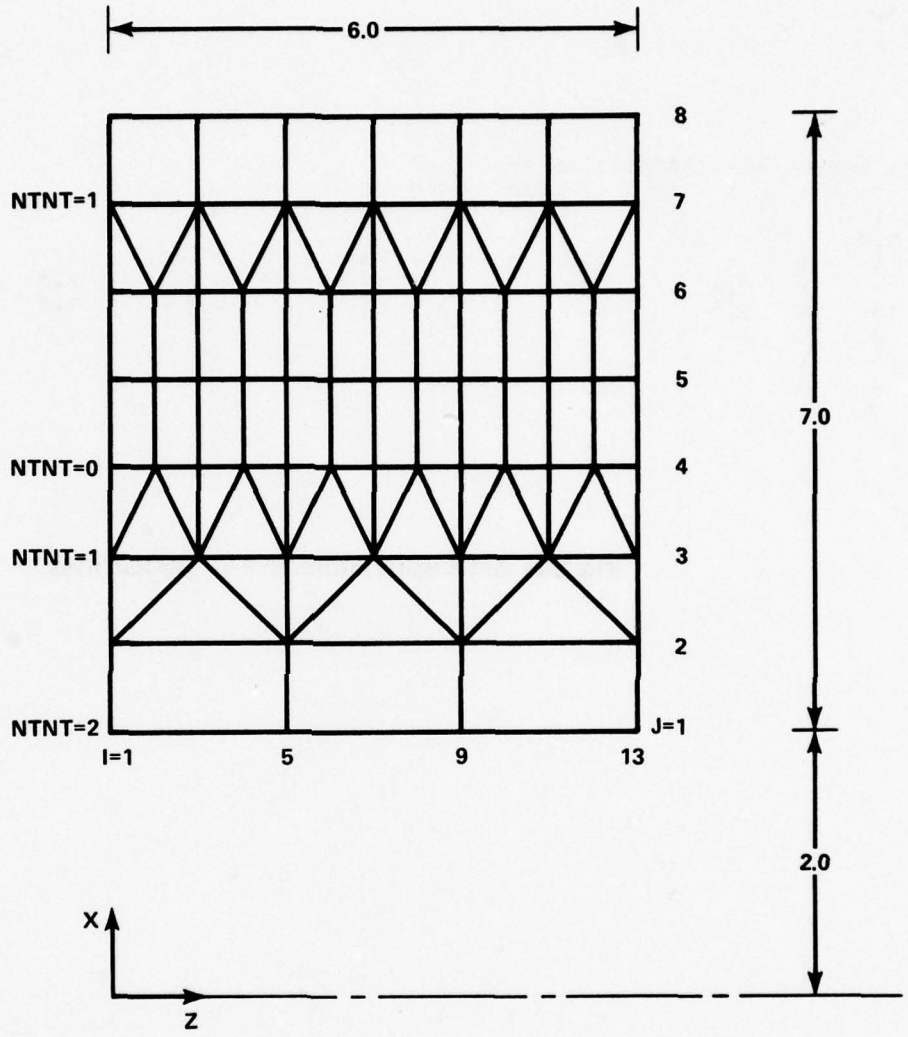


FIG. B-40 PLANNED FINITE ELEMENT MODEL AND CONFIGURATION OF A SOLID CYLINDRICAL RING CONTAINING COARSE TO FINE THEN BACK TO COARSE REGIONS.

```
*** SAMPLE 6 - TRANSITIONS ***
   1     1     1     1     7     0     0     1
   1
  0.0
   4     1     8     1    13     0     0     3     0     0  456     0
   1     1   0.0         2.0         1    13     1   6.0         2.0         1
  13     8   6.0         9.0         1     1     8   0.0         9.0         1
   2
   3     1
   4     0
   7     1
```

FIG. B-41 DATA INPUT PROBLEM B-VI TRANSITIONS

XX GRID NUMBERS
(XX) ELEMENT NUMBERS

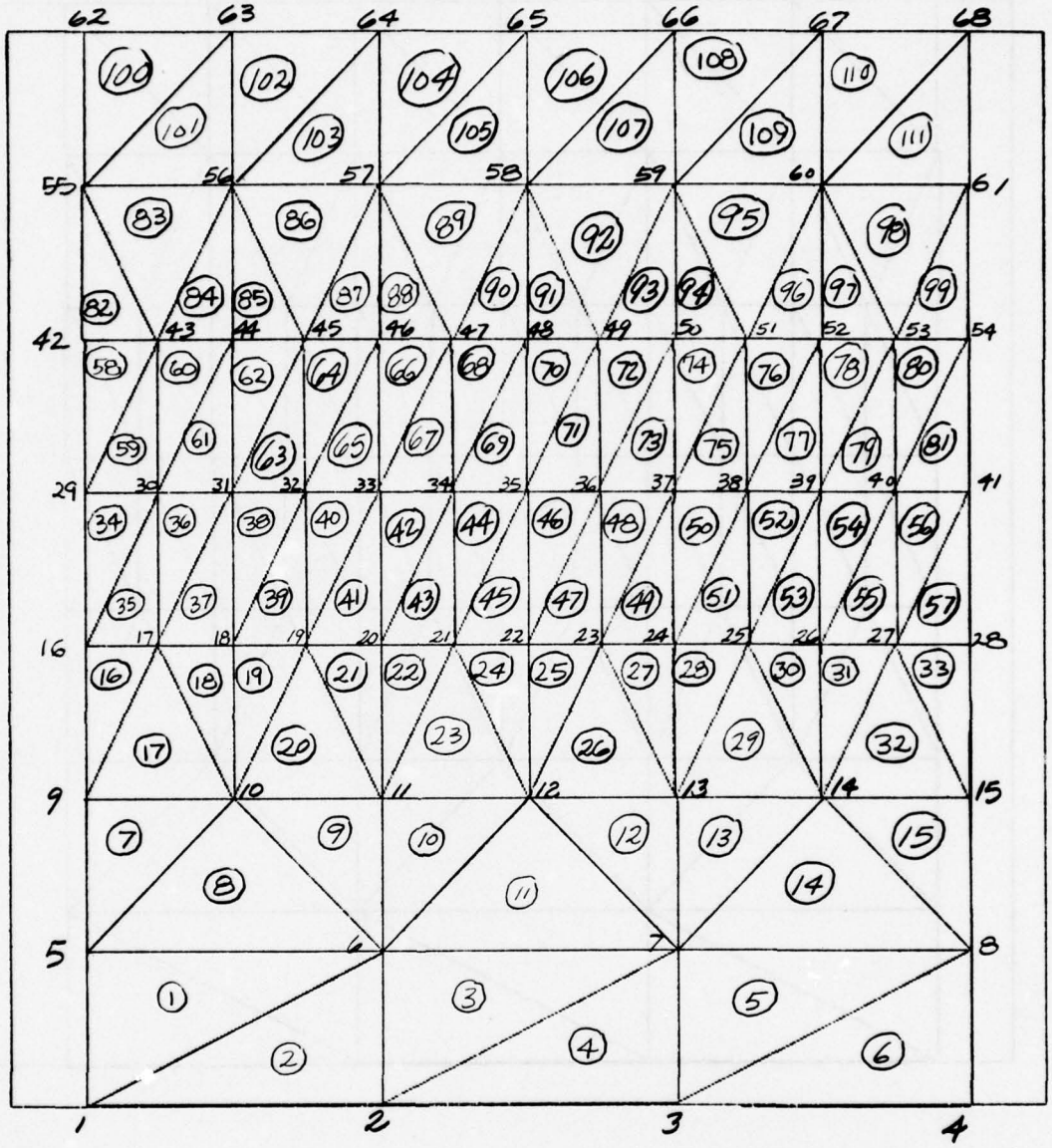


FIG. B-42 GRID POINT AND ELEMENT NUMBERS

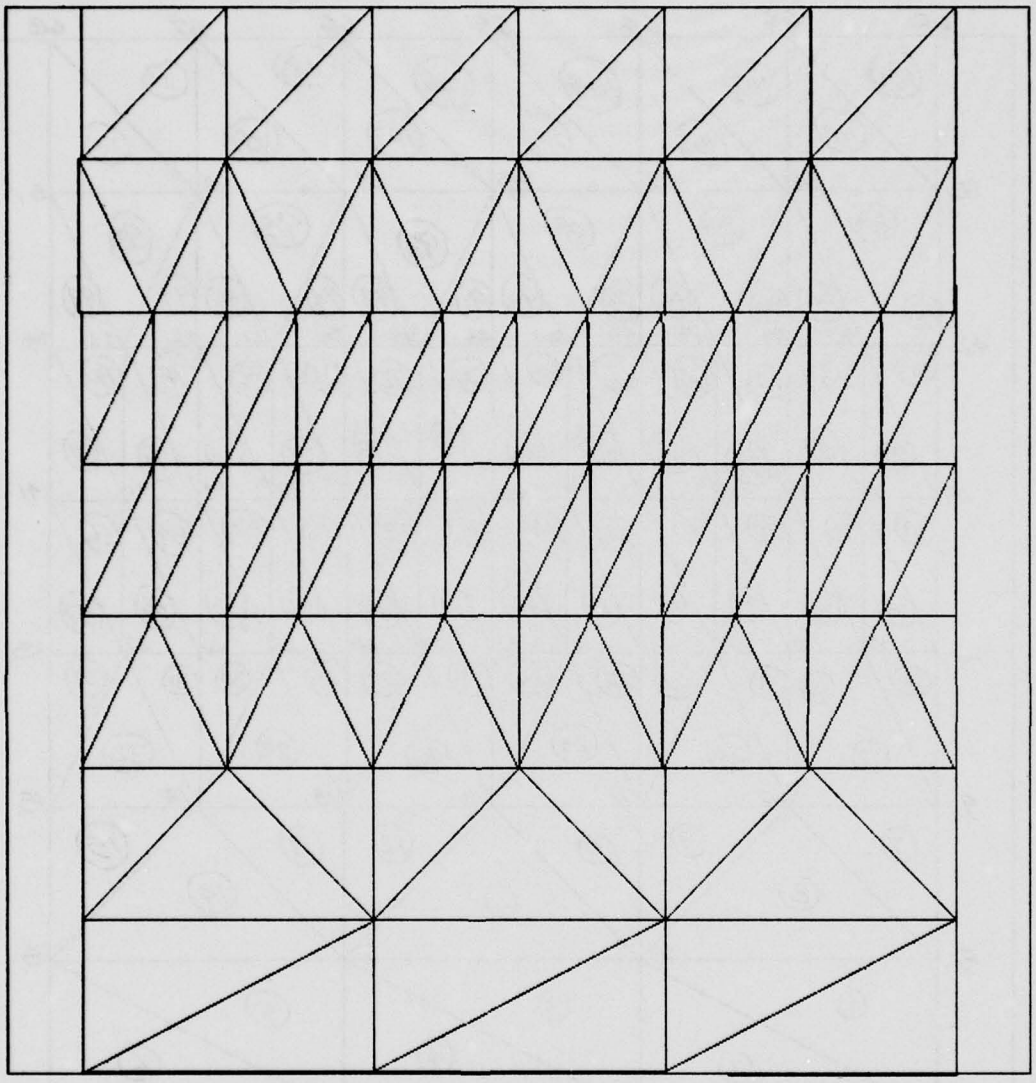


FIG. B-43 NASTRAN STRUCTURAL PLOT

LISTING OF PUNCHED NASTRAN BULK DATA CARDS
PROBLEM B-VI TRANSITION

```
**********************************************************
**********************************************************
**                                                      **
**   JUNCTION INPUT GENERATOR PROGRAM   (JIG)           **
**                                                      **
**********************************************************
**********************************************************
```

*** SAMPLE 6 - TRANSITIONS ***

```
NST =      1
NGS =      1
NES =      1
NPOP =     1
MID =      7
NGP =      0
IDELT =    0
NSECT =    1
NT( 1) =     1     DELTZ( 1) =     0.0000
```

I	J	Z(I,J)	X(I,J)	CODE(I,J)
1	1	0.00000	2.00000	1
2	1	.50000	2.00000	1
3	1	1.00000	2.00000	1
4	1	1.50000	2.00000	1
5	1	2.00000	2.00000	1
6	1	2.50000	2.00000	1
7	1	3.00000	2.00000	1
8	1	3.50000	2.00000	1
9	1	4.00000	2.00000	1
10	1	4.50000	2.00000	1
11	1	5.00000	2.00000	1
12	1	5.50000	2.00000	1
13	1	6.00000	2.00000	1
1	2	0.00000	3.00000	1
2	2	.49999	3.00001	0
3	2	1.00002	3.00004	0
4	2	1.50002	3.00003	0
5	2	2.00002	3.00001	0
6	2	2.50003	3.00003	0
7	2	3.00002	3.00002	0
8	2	3.50002	3.00001	0
9	2	4.00001	3.00002	0
10	2	4.49997	2.99996	0
11	2	5.00002	3.00002	0
12	2	5.49999	2.99999	0
13	2	6.00000	3.00000	1
1	3	0.00000	4.00000	1
2	3	.50001	4.00004	0
3	3	1.00001	4.00006	0
4	3	1.50001	4.00003	0
5	3	2.00003	4.00002	0
6	3	2.50003	4.00003	0
7	3	3.00001	4.00002	0
8	3	3.50002	4.00003	0
9	3	3.99998	3.99998	0
10	3	4.49999	3.99997	0
11	3	5.00001	4.00001	0
12	3	5.50000	3.99999	0
13	3	6.00000	4.00000	1
1	4	0.00000	5.00000	1
2	4	.50000	5.00004	0
3	4	1.00000	5.00004	0
4	4	1.50001	5.00001	0
5	4	2.00002	5.00002	0
6	4	2.50002	5.00003	0
7	4	3.00003	5.00004	0
8	4	3.50000	5.00000	0
9	4	4.00000	4.99999	0
10	4	4.49998	4.99997	0
11	4	5.00001	5.00000	0
12	4	5.49999	4.99999	0
13	4	6.00000	5.00000	1
1	5	0.00000	6.00000	1
2	5	.49999	6.00002	0
3	5	.99998	5.99998	0
4	5	1.49998	5.99996	0
5	5	2.00000	6.00000	0
6	5	2.50001	6.00002	0

```
      7     5     2.99999      5.99999     0
      8     5     3.49999      5.99997     0
      9     5     3.99998      5.99997     0
     10     5     4.49997      5.99995     0
     11     5     4.99999      5.99999     0
     12     5     5.49999      5.99998     0
     13     5     6.00000      6.00000     1
      1     6     0.00000      7.00000     1
      2     6      .49997      6.99997     0
      3     6      .99996      6.99995     0
      4     6     1.49997      6.99997     0
      5     6     2.00001      7.00002     0
      6     6     2.49999      7.00001     0
      7     6     2.99999      6.99998     0
      8     6     3.49999      6.99999     0
      9     6     3.99998      6.99998     0
     10     6     4.49998      6.99997     0
     11     6     5.00000      7.00001     0
     12     6     5.50001      7.00001     0
     13     6     6.00000      7.00000     1
      1     7     0.00000      8.00000     1
      2     7      .49998      7.99998     0
      3     7      .99998      7.99998     0
      4     7     1.50001      8.00001     0
      5     7     2.00001      8.00002     0
      6     7     2.49999      8.00000     0
      7     7     3.00000      8.00000     0
      8     7     3.50000      8.00000     0
      9     7     4.00000      7.99999     0
     10     7     4.49999      7.99998     0
     11     7     5.00002      8.00002     0
     12     7     5.50000      7.99999     0
     13     7     6.00000      8.00000     1
      1     8     0.00000      9.00000     1
      2     8      .50000      9.00000     1
      3     8     1.00000      9.00000     1
      4     8     1.50000      9.00000     1
      5     8     2.00000      9.00000     1
      6     8     2.50000      9.00000     1
      7     8     3.00000      9.00000     1
      8     8     3.50000      9.00000     1
      9     8     4.00000      9.00000     1
     10     8     4.50000      9.00000     1
     11     8     5.00000      9.00000     1
     12     8     5.50000      9.00000     1
     13     8     6.00000      9.00000     1
GRID         1       0  2.0000  0.0000  0.0000     0     456
GRID         2       0  2.0000  0.0000  2.0000     0     456
GRID         3       0  2.0000  0.0000  4.0000     0     456
GRID         4       0  2.0000  0.0000  6.0000     0     456
GRID         5       0  3.0000  0.0000  0.0000     0     456
GRID         6       0  3.0000  0.0000  2.0000     0     456
CTRIARG      1       6       5       1  0.0000     7
CTRIARG      2       1       2       6  0.0000     7
GRID         7       0  3.0000  0.0000  4.0000     0     456
CTRIARG      3       7       6       2  0.0000     7
CTRIARG      4       2       3       7  0.0000     7
GRID         8       0  3.0000  0.0000  6.0000     0     456
CTRIARG      5       8       7       3  0.0000     7
CTRIARG      6       3       4       8  0.0000     7
GRID         9       0  4.0000  0.0000  0.0000     0     456
GRID        10       0  4.0001  0.0000  1.0000     0     456
GRID        11       0  4.0000  0.0000  2.0000     0     456
CTRIARG      7      10       9       5  0.0000     7
```

```
CTRIARG         8        5        6       10   0.0000        7
CTRIARG         9        6       11       10   0.0000        7
GRID           12        0  4.0000   0.0000   3.0000        0      456
GRID           13        0  4.0000   0.0000   4.0000        0      456
CTRIARG        10       12       11        6   0.0000        7
CTRIARG        11        6        7       12   0.0000        7
CTRIARG        12        7       13       12   0.0000        7
GRID           14        0  4.0000   0.0000   5.0000        0      456
GRID           15        0  4.0000   0.0000   6.0000        0      456
CTRIARG        13       14       13        7   0.0000        7
CTRIARG        14        7        8       14   0.0000        7
CTRIARG        15        8       15       14   0.0000        7
GRID           16        0  5.0000   0.0000   0.0000        0      456
GRID           17        0  5.0000   0.0000    .5000        0      456
GRID           18        0  5.0000   0.0000   1.0000        0      456
CTRIARG        16       17       16        9   0.0000        7
CTRIARG        17        9       10       17   0.0000        7
CTRIARG        18       10       18       17   0.0000        7
GRID           19        0  5.0000   0.0000   1.5000        0      456
GRID           20        0  5.0000   0.0000   2.0000        0      456
CTRIARG        19       19       18       10   0.0000        7
CTRIARG        20       10       11       19   0.0000        7
CTRIARG        21       11       20       19   0.0000        7
GRID           21        0  5.0000   0.0000   2.5000        0      456
GRID           22        0  5.0000   0.0000   3.0000        0      456
CTRIARG        22       21       20       11   0.0000        7
CTRIARG        23       11       12       21   0.0000        7
CTRIARG        24       12       22       21   0.0000        7
GRID           23        0  5.0000   0.0000   3.5000        0      456
GRID           24        0  5.0000   0.0000   4.0000        0      456
CTRIARG        25       23       22       12   0.0000        7
CTRIARG        26       12       13       23   0.0000        7
CTRIARG        27       13       24       23   0.0000        7
GRID           25        0  5.0000   0.0000   4.5000        0      456
GRID           26        0  5.0000   0.0000   5.0000        0      456
CTRIARG        28       25       24       13   0.0000        7
CTRIARG        29       13       14       25   0.0000        7
CTRIARG        30       14       26       25   0.0000        7
GRID           27        0  5.0000   0.0000   5.5000        0      456
GRID           28        0  5.0000   0.0000   6.0000        0      456
CTRIARG        31       27       26       14   0.0000        7
CTRIARG        32       14       15       27   0.0000        7
CTRIARG        33       15       28       27   0.0000        7
GRID           29        0  6.0000   0.0000   0.0000        0      456
GRID           30        0  6.0000   0.0000    .5000        0      456
CTRIARG        34       30       29       16   0.0000        7
CTRIARG        35       16       17       30   0.0000        7
GRID           31        0  6.0000   0.0000   1.0000        0      456
CTRIARG        36       31       30       17   0.0000        7
CTRIARG        37       17       18       31   0.0000        7
GRID           32        0  6.0000   0.0000   1.5000        0      456
CTRIARG        38       32       31       18   0.0000        7
CTRIARG        39       18       19       32   0.0000        7
GRID           33        0  6.0000   0.0000   2.0000        0      456
CTRIARG        40       33       32       19   0.0000        7
CTRIARG        41       19       20       33   0.0000        7
GRID           34        0  6.0000   0.0000   2.5000        0      456
CTRIARG        42       34       33       20   0.0000        7
CTRIARG        43       20       21       34   0.0000        7
GRID           35        0  6.0000   0.0000   3.0000        0      456
CTRIARG        44       35       34       21   0.0000        7
CTRIARG        45       21       22       35   0.0000        7
GRID           36        0  6.0000   0.0000   3.5000        0      456
CTRIARG        46       36       35       22   0.0000        7
```

```
CTRIARG     47      22      23      36  0.0000      7
GRID        37       0 6.0000 0.0000  4.0000      0     456
CTRIARG     48      37      36      23  0.0000      7
CTRIARG     49      23      24      37  0.0000      7
GRID        38       0 5.9999 0.0000  4.5000      0     456
CTRIARG     50      38      37      24  0.0000      7
CTRIARG     51      24      25      38  0.0000      7
GRID        39       0 6.0000 0.0000  5.0000      0     456
CTRIARG     52      39      38      25  0.0000      7
CTRIARG     53      25      26      39  0.0000      7
GRID        40       0 6.0000 0.0000  5.5000      0     456
CTRIARG     54      40      39      26  0.0000      7
CTRIARG     55      26      27      40  0.0000      7
GRID        41       0 6.0000 0.0000  6.0000      0     456
CTRIARG     56      41      40      27  0.0000      7
CTRIARG     57      27      28      41  0.0000      7
GRID        42       0 7.0000 0.0000  0.0000      0     456
GRID        43       0 7.0000 0.0000   .5000      0     456
CTRIARG     58      43      42      29  0.0000      7
CTRIARG     59      29      30      43  0.0000      7
GRID        44       0 7.0000 0.0000  1.0000      0     456
CTRIARG     60      44      43      30  0.0000      7
CTRIARG     61      30      31      44  0.0000      7
GRID        45       0 7.0000 0.0000  1.5000      0     456
CTRIARG     62      45      44      31  0.0000      7
CTRIARG     63      31      32      45  0.0000      7
GRID        46       0 7.0000 0.0000  2.0000      0     456
CTRIARG     64      46      45      32  0.0000      7
CTRIARG     65      32      33      46  0.0000      7
GRID        47       0 7.0000 0.0000  2.5000      0     456
CTRIARG     66      47      46      33  0.0000      7
CTRIARG     67      33      34      47  0.0000      7
GRID        48       0 7.0000 0.0000  3.0000      0     456
CTRIARG     68      48      47      34  0.0000      7
CTRIARG     69      34      35      48  0.0000      7
GRID        49       0 7.0000 0.0000  3.5000      0     456
CTRIARG     70      49      48      35  0.0000      7
CTRIARG     71      35      36      49  0.0000      7
GRID        50       0 7.0000 0.0000  4.0000      0     456
CTRIARG     72      50      49      36  0.0000      7
CTRIARG     73      36      37      50  0.0000      7
GRID        51       0 7.0000 0.0000  4.5000      0     456
CTRIARG     74      51      50      37  0.0000      7
CTRIARG     75      37      38      51  0.0000      7
GRID        52       0 7.0000 0.0000  5.0000      0     456
CTRIARG     76      52      51      38  0.0000      7
CTRIARG     77      38      39      52  0.0000      7
GRID        53       0 7.0000 0.0000  5.5000      0     456
CTRIARG     78      53      52      39  0.0000      7
CTRIARG     79      39      40      53  0.0000      7
GRID        54       0 7.0000 0.0000  6.0000      0     456
CTRIARG     80      54      53      40  0.0000      7
CTRIARG     81      40      41      54  0.0000      7
GRID        55       0 8.0000 0.0000  0.0000      0     456
GRID        56       0 8.0000 0.0000  1.0000      0     456
CTRIARG     82      42      43      55  0.0000      7
CTRIARG     83      43      56      55  0.0000      7
CTRIARG     84      43      44      56  0.0000      7
GRID        57       0 8.0000 0.0000  2.0000      0     456
CTRIARG     85      44      45      56  0.0000      7
CTRIARG     86      45      57      56  0.0000      7
CTRIARG     87      45      46      57  0.0000      7
GRID        58       0 8.0000 0.0000  3.0000      0     456
CTRIARG     88      46      47      57  0.0000      7
```

CTRIARG	89	47	58	57	0.0000	7	
CTRIARG	90	47	48	58	0.0000	7	
GRID	59	0	8.0000	0.0000	4.0000	0	456
CTRIARG	91	48	49	58	0.0000	7	
CTRIARG	92	49	59	58	0.0000	7	
CTRIARG	93	49	50	59	0.0000	7	
GRID	60	0	8.0000	0.0000	5.0000	0	456
CTRIARG	94	50	51	59	0.0000	7	
CTRIARG	95	51	60	59	0.0000	7	
CTRIARG	96	51	52	60	0.0000	7	
GRID	61	0	8.0000	0.0000	6.0000	0	456
CTRIARG	97	52	53	60	0.0000	7	
CTRIARG	98	53	61	60	0.0000	7	
CTRIARG	99	53	54	61	0.0000	7	
GRID	62	0	9.0000	0.0000	0.0000	0	456
GRID	63	0	9.0000	0.0000	1.0000	0	456
CTRIARG	100	63	62	55	0.0000	7	
CTRIARG	101	55	56	63	0.0000	7	
GRID	64	0	9.0000	0.0000	2.0000	0	456
CTRIARG	102	64	63	56	0.0000	7	
CTRIARG	103	56	57	64	0.0000	7	
GRID	65	0	9.0000	0.0000	3.0000	0	456
CTRIARG	104	65	64	57	0.0000	7	
CTRIARG	105	57	58	65	0.0000	7	
GRID	66	0	9.0000	0.0000	4.0000	0	456
CTRIARG	106	66	65	58	0.0000	7	
CTRIARG	107	58	59	66	0.0000	7	
GRID	67	0	9.0000	0.0000	5.0000	0	456
CTRIARG	108	67	66	59	0.0000	7	
CTRIARG	109	59	60	67	0.0000	7	
GRID	68	0	9.0000	0.0000	6.0000	0	456
CTRIARG	110	68	67	60	0.0000	7	
CTRIARG	111	60	61	68	0.0000	7	

PROBLEM B-VII

MPC GENERATOR

The following problem demonstrates the JIG MPC generator. This feature generates the required NASTRAN MPC cards used to connect the solid wedge elements to plate elements. In an actual missile, the joint can be represented by the solid wedge elements and the shell by plate elements. Therefore the wedge elements can have shell elements either forward or aft of the joint or on both sides of the joint. Figure B-44 shows the planned finite element model and configuration of a missile joint. Only one half of the joint was modeled. Similar type of model preparation would be required if one were to model both halves of the joint.

A complete listing of the data input is shown in Figure B-45. Figure B-46 shows the grid point and element identification numbers as generated by JIG. Figures B-47 and B-48 give two views of the NASTRAN structural plots of the finite element model and are followed by a listing of the JIG punched output.

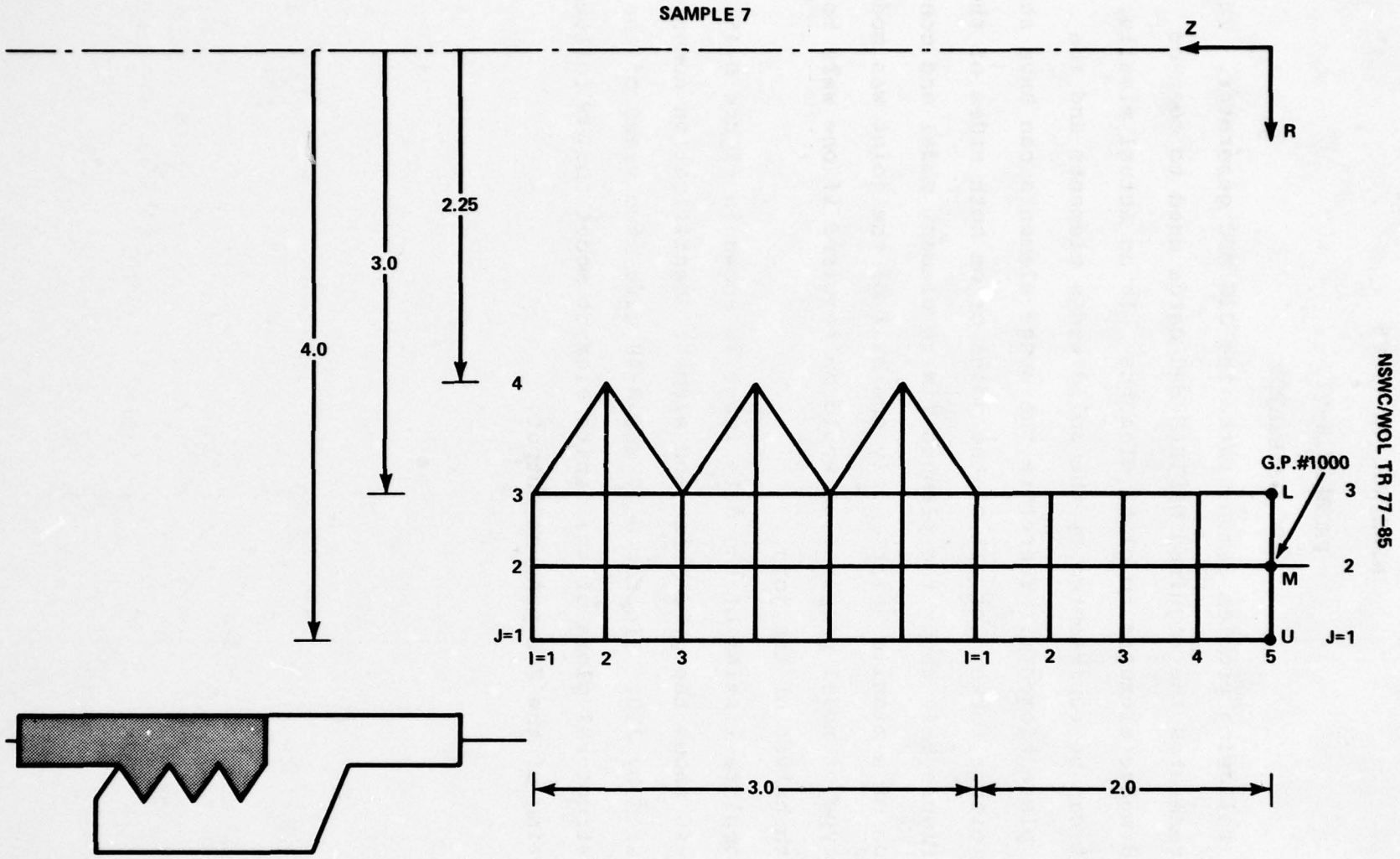


FIG. B-44 PLANNED FINITE ELEMENT MODEL AND CONFIGURATION OF A MISSILE JOINT.

```
*** SAMPLE 7 - JOINT WITH MPC ***
   2     1     1     3    10     0     1     1
   3     1
 -1.0         0.0
   1     1   100
   1     0.0         3   90.0
  0.0         90.0
   1     4
   4     1     3     1     3     0     1     0     1     3  456     0
   4     4.5         2.25
   1     1    5.0          4.0          1     3     1     4.0          4.0          1
   3     3    4.0          3.0          1     1     3     5.0          3.0          1
   4     1     3     1     5     1     0     0     1     3  456     1
   1
   5     1     5     2     5     3     1     5     0
   1     1    2.0          4.0          1     5     1     0.0          4.0          1
   5     3     0.0         3.0          1     1     3     2.0          3.0          1
   1
   5     2    0.0          3.5       1000     1
2456 2456                 456   246   246
```

FIG. 3-45 DATA INPUT PROBLEM B-VII MPC GENERATOR

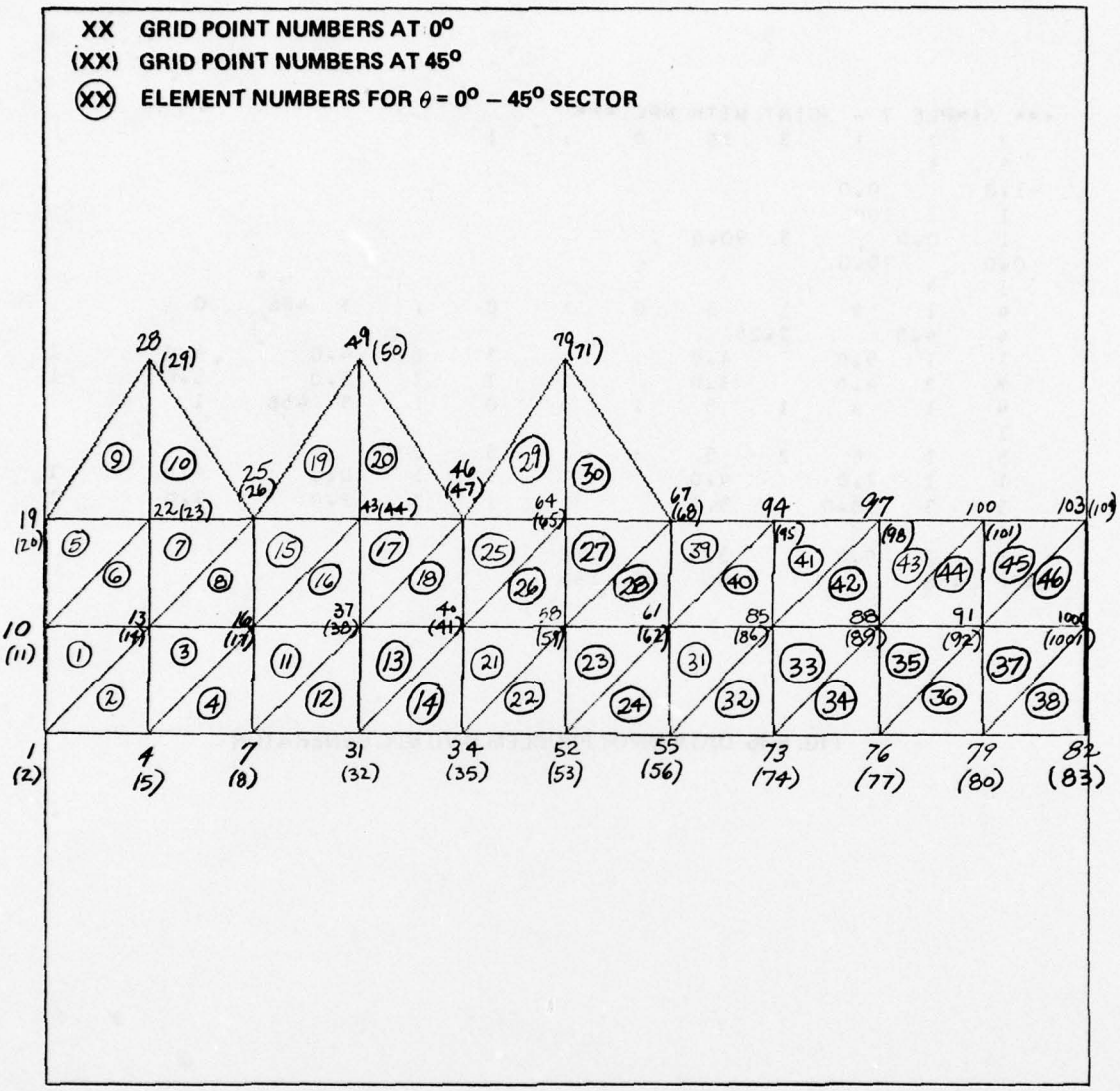


FIG. B-46 GRID POINT AND ELEMENT NUMBERS

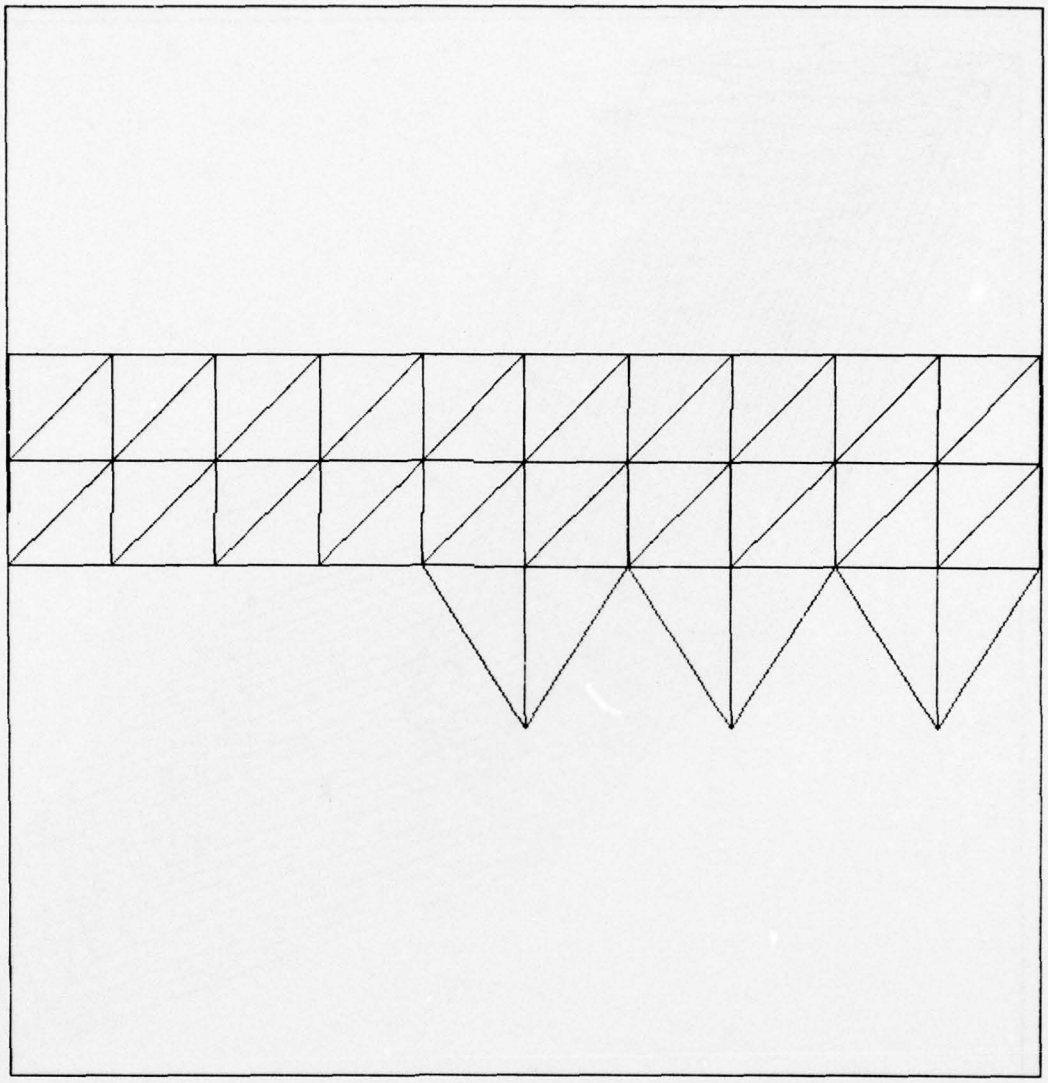


FIG. B-47 NASTRAN STRUCTURAL PLOT SHOWING CROSS SECTIONS OF JOINT.

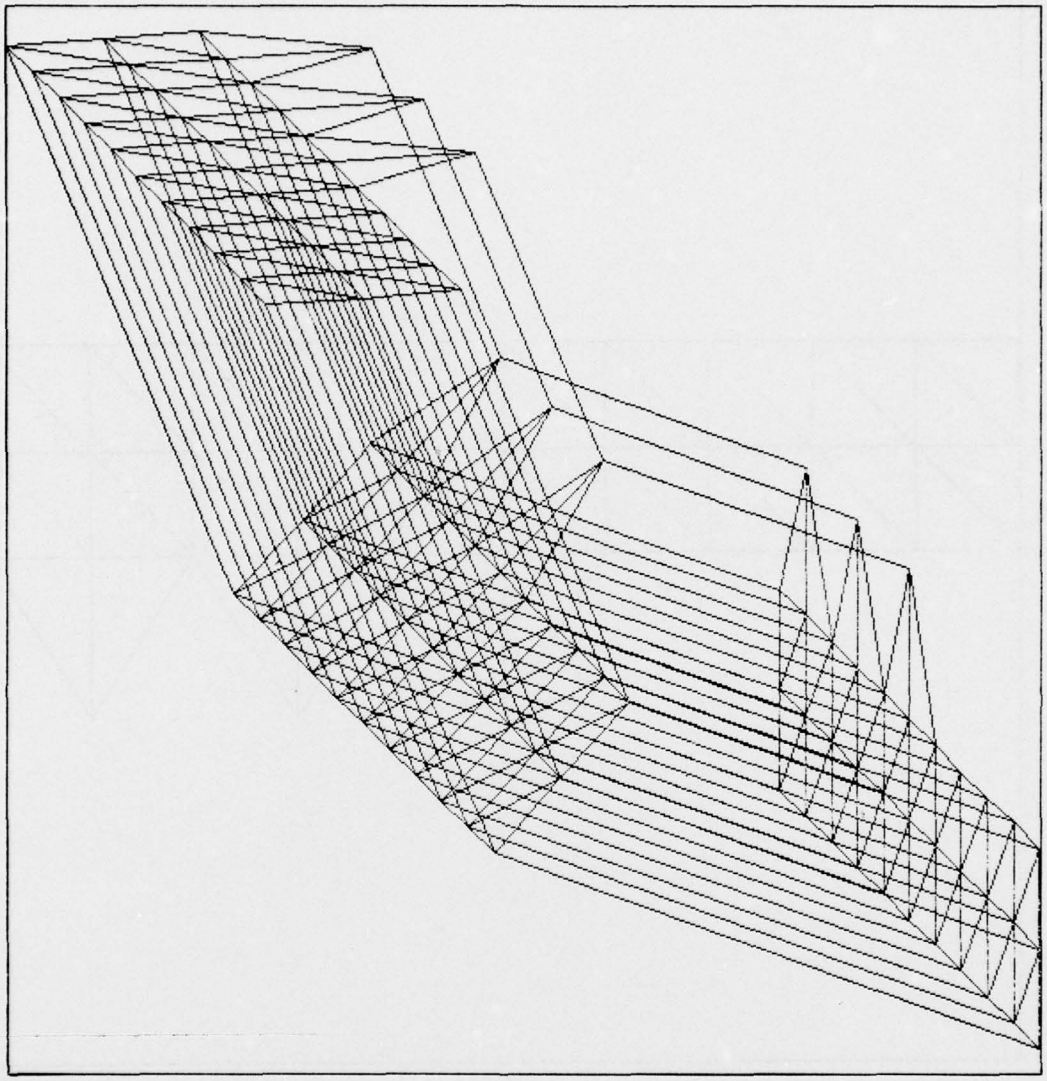


FIG. B-48 NASTRAN STRUCTURAL PLOT ROTATED VIEW

LISTING OF PUNCHED NASTRAN BULK DATA CARDS
PROBLEM B-VII MPC GENERATOR

```
**********************************************
**********************************************
**                                          **
**   JUNCTION INPUT GENERATOR PROGRAM  (JIG) **
**                                          **
**********************************************
**********************************************
```

*** SAMPLE 7 - JOINT WITH MPC ***

```
NST =      2
NGS =      1
NES =      1
NPOP =     3
MID =     10
NGP =      0
IDELT =    1
NSECT =    1
NT( 1) =     3     DELTZ( 1) =    -1.0000
NT( 2) =     1     DELTZ( 2) =     0.0000
NDT =      1
ICLOSE =   1
DELGP =  100
KK( 1) =     1     THETA( 1) =     0.0000
KK( 2) =     3     THETA( 2) =    90.0000
BETA( 1) =     0.0000
BETA( 2) =    90.0000
JB( 1) =     1     JE( 1) =     4
```

I	J	Z(I,J)	X(I,J)	CODE(I,J)
1	1	5.00000	4.00000	1
2	1	4.50000	4.00000	1
3	1	4.00000	4.00000	1
1	2	5.00000	3.50000	1
2	2	4.50003	3.50003	0
3	2	4.00000	3.50000	1
1	3	5.00000	3.00000	1
2	3	4.50000	3.00000	1
3	3	4.00000	3.00000	1
1	4	4.50000	2.25000	1

```
GRID          1       1  4.0000   0.0000  5.0000       1     456
GRID          2       1  4.0000  45.0000  5.0000       1     456
GRID          3       1  4.0000  90.0000  5.0000       1     456
GRID          4       1  4.0000   0.0000  4.5000       1     456
GRID          5       1  4.0000  45.0000  4.5000       1     456
GRID          6       1  4.0000  90.0000  4.5000       1     456
GRID          7       1  4.0000   0.0000  4.0000       1     456
GRID          8       1  4.0000  45.0000  4.0000       1     456
GRID          9       1  4.0000  90.0000  4.0000       1     456
GRID         10       1  3.5000   0.0000  5.0000       1     456
GRID         11       1  3.5000  45.0000  5.0000       1     456
GRID         12       1  3.5000  90.0000  5.0000       1     456
GRID         13       1  3.5000   0.0000  4.5000       1     456
GRID         14       1  3.5000  45.0000  4.5000       1     456
GRID         15       1  3.5000  90.0000  4.5000       1     456
CWEDGE        1      10      13      10       1      14      11       2
CWEDGE      101      10      14      11       2      15      12       3
CWEDGE        2      10       1       4      13       2       5      14
CWEDGE      102      10       2       5      14       3       6      15
GRID         16       1  3.5000   0.0000  4.0000       1     456
GRID         17       1  3.5000  45.0000  4.0000       1     456
GRID         18       1  3.5000  90.0000  4.0000       1     456
CWEDGE        3      10      16      13       4      17      14       5
CWEDGE      103      10      17      14       5      18      15       6
CWEDGE        4      10       4       7      16       5       8      17
CWEDGE      104      10       5       8      17       6       9      18
GRID         19       1  3.0000   0.0000  5.0000       1     456
GRID         20       1  3.0000  45.0000  5.0000       1     456
GRID         21       1  3.0000  90.0000  5.0000       1     456
GRID         22       1  3.0000   0.0000  4.5000       1     456
GRID         23       1  3.0000  45.0000  4.5000       1     456
GRID         24       1  3.0000  90.0000  4.5000       1     456
CWEDGE        5      10      22      19      10      23      20      11
CWEDGE      105      10      23      20      11      24      21      12
CWEDGE        6      10      10      13      22      11      14      23
CWEDGE      106      10      11      14      23      12      15      24
GRID         25       1  3.0000   0.0000  4.0000       1     456
GRID         26       1  3.0000  45.0000  4.0000       1     456
GRID         27       1  3.0000  90.0000  4.0000       1     456
CWEDGE        7      10      25      22      13      26      23      14
CWEDGE      107      10      26      23      14      27      24      15
CWEDGE        8      10      13      16      25      14      17      26
CWEDGE      108      10      14      17      26      15      18      27
GRID         28       1  2.2500   0.0000  4.5000       1     456
GRID         29       1  2.2500  45.0000  4.5000       1     456
GRID         30       1  2.2500  90.0000  4.5000       1     456
CWEDGE        9      10      22      28      19      23      29      20
CWEDGE      109      10      23      29      20      24      30      21
```

```
CWEDGE      10      10      25      28      22      26      29      23
CWEDGE     110      10      26      29      23      27      38      24


    I     J     Z(I,J)        X(I,J)   CODE(I,J)

    1     1    4.00000       4.00000      1
    2     1    3.50000       4.00000      1
    3     1    3.00000       4.00000      1
    1     2    4.00000       3.50000      1
    2     2    3.50003       3.50003      0
    3     2    3.00000       3.50000      1
    1     3    4.00000       3.00000      1
    2     3    3.50000       3.00000      1
    3     3    3.00000       3.00000      1
    1     4    3.50000       2.25000      1
GRID       31       1  4.0000   0.0000  3.5000       1     456
GRID       32       1  4.0000  45.0000  3.5000       1     456
GRID       33       1  4.0000  90.0000  3.5000       1     456
GRID       34       1  4.0000   0.0000  3.0000       1     456
GRID       35       1  4.0000  45.0000  3.0000       1     456
GRID       36       1  4.0000  90.0000  3.0000       1     456
GRID       37       1  3.5000   0.0000  3.5000       1     456
GRID       38       1  3.5000  45.0000  3.5000       1     456
GRID       39       1  3.5000  90.0000  3.5000       1     456
CWEDGE     11      10      37      16       7      38      17       8
CWEDGE    111      10      38      17       8      39      18       9
CWEDGE     12      10       7      31      37       8      32      38
CWEDGE    112      10       8      32      38       9      33      39
GRID       40       1  3.5000   0.0000  3.0000       1     456
GRID       41       1  3.5000  45.0000  3.0000       1     456
GRID       42       1  3.5000  90.0000  3.0000       1     456
CWEDGE     13      10      40      37      31      41      38      32
CWEDGE    113      10      41      38      32      42      39      33
CWEDGE     14      10      31      34      40      32      35      41
CWEDGE    114      10      32      35      41      33      36      42
GRID       43       1  3.0000   0.0000  3.5000       1     456
GRID       44       1  3.0000  45.0000  3.5000       1     456
GRID       45       1  3.0000  90.0000  3.5000       1     456
CWEDGE     15      10      43      25      16      44      26      17
CWEDGE    115      10      44      26      17      45      27      18
CWEDGE     16      10      16      37      43      17      38      44
CWEDGE    116      10      17      38      44      18      39      45
GRID       46       1  3.0000   0.0000  3.0000       1     456
GRID       47       1  3.0000  45.0000  3.0000       1     456
GRID       48       1  3.0000  90.0000  3.0000       1     456
CWEDGE     17      10      46      43      37      47      44      38
CWEDGE    117      10      47      44      38      48      45      39
CWEDGE     18      10      37      40      46      38      41      47
CWEDGE    118      10      38      41      47      39      42      48
GRID       49       1  2.2500   0.0000  3.5000       1     456
GRID       50       1  2.2500  45.0000  3.5000       1     456
GRID       51       1  2.2500  90.0000  3.5000       1     456
CWEDGE     19      10      43      49      25      44      50      26
CWEDGE    119      10      44      50      26      45      51      27
CWEDGE     20      10      46      49      43      47      50      44
CWEDGE    120      10      47      50      44      48      51      45


    I     J     Z(I,J)        X(I,J)   CODE(I,J)

    1     1    3.00000       4.00000      1
```

```
     2     1      2.50000      4.00000     1
     3     1      2.00000      4.00000     1
     1     2      3.00000      3.50000     1
     2     2      2.50003      3.50003     0
     3     2      2.00000      3.50000     1
     1     3      3.00000      3.00000     1
     2     3      2.50000      3.00000     1
     3     3      2.00000      3.00000     1
     1     4      2.50000      2.25000     1
GRID          52         1  4.0000   0.0000  2.5000        1      456
GRID          53         1  4.0000  45.0000  2.5000        1      456
GRID          54         1  4.0000  90.0000  2.5000        1      456
GRID          55         1  4.0000   0.0000  2.0000        1      456
GRID          56         1  4.0000  45.0000  2.0000        1      456
GRID          57         1  4.0000  90.0000  2.0000        1      456
GRID          58         1  3.5000   0.0000  2.5000        1      456
GRID          59         1  3.5000  45.0000  2.5000        1      456
GRID          60         1  3.5000  90.0000  2.5000        1      456
CWEDGE        21        10       58       40       34       59       41       35
CWEDGE       121        10       59       41       35       60       42       36
CWEDGE        22        10       34       52       58       35       53       59
CWEDGE       122        10       35       53       59       36       54       60
GRID          61         1  3.5000   0.0000  2.0000        1      456
GRID          62         1  3.5000  45.0000  2.0000        1      456
GRID          63         1  3.5000  90.0000  2.0000        1      456
CWEDGE        23        10       61       58       52       62       59       53
CWEDGE       123        10       62       59       53       63       60       54
CWEDGE        24        10       52       55       61       53       56       62
CWEDGE       124        10       53       56       62       54       57       63
GRID          64         1  3.0000   0.0000  2.5000        1      456
GRID          65         1  3.0000  45.0000  2.5000        1      456
GRID          66         1  3.0000  90.0000  2.5000        1      456
CWEDGE        25        10       64       46       40       65       47       41
CWEDGE       125        10       65       47       41       66       48       42
CWEDGE        26        10       40       58       64       41       59       65
CWEDGE       126        10       41       59       65       42       60       66
GRID          67         1  3.0000   0.0000  2.0000        1      456
GRID          68         1  3.0000  45.0000  2.0000        1      456
GRID          69         1  3.0000  90.0000  2.0000        1      456
CWEDGE        27        10       67       64       58       68       65       59
CWEDGE       127        10       68       65       59       69       66       60
CWEDGE        28        10       58       61       67       59       62       68
CWEDGE       128        10       59       62       68       60       63       69
GRID          70         1  2.2500   0.0000  2.5000        1      456
GRID          71         1  2.2500  45.0000  2.5000        1      456
GRID          72         1  2.2500  90.0000  2.5000        1      456
CWEDGE        29        10       64       70       46       65       71       47
CWEDGE       129        10       65       71       47       66       72       48
CWEDGE        30        10       67       70       64       68       71       65
CWEDGE       130        10       68       71       65       69       72       66
```

```
     I     J      Z(I,J)       X(I,J)  CODE(I,J)

     1     1      2.00000      4.00000     1
     2     1      1.50000      4.00000     1
     3     1      1.00000      4.00000     1
     4     1       .50000      4.00000     1
     5     1      0.00000      4.00000     1
     1     2      2.00000      3.50000     1
     2     2      1.50001      3.50001     0
     3     2      1.00001      3.50001     0
     4     2       .50001      3.50003     0
```

```
     5     2      0.00000      3.50000      2
     1     3      2.00000      3.00000      1
     2     3      1.50000      3.00000      1
     3     3      1.00000      3.00000      1
     4     3       .50000      3.00000      1
     5     3      0.00000      3.00000      1
GRID          73         1   4.0000   0.0000   1.5000        1      456
GRID          74         1   4.0000  45.0000   1.5000        1      456
GRID          75         1   4.0000  90.0000   1.5000        1      456
GRID          76         1   4.0000   0.0000   1.0000        1      456
GRID          77         1   4.0000  45.0000   1.0000        1      456
GRID          78         1   4.0000  90.0000   1.0000        1      456
GRID          79         1   4.0000   0.0000    .5000        1      456
GRID          80         1   4.0000  45.0000    .5000        1      456
GRID          81         1   4.0000  90.0000    .5000        1      456
GRID          82         1    4.000    0.000    0.000        1     2456
GRID          83         1    4.000   45.000    0.000        1      456
GRID          84         1    4.000   90.000    0.000        1     2456
GRID          85         1   3.5000   0.0000   1.5000        1      456
GRID          86         1   3.5000  45.0000   1.5000        1      456
GRID          87         1   3.5000  90.0000   1.5000        1      456
CWEDGE        31        10       85       61       55       86       62       56
CWEDGE       131        10       86       62       56       87       63       57
CWEDGE        32        10       55       73       85       56       74       86
CWEDGE       132        10       56       74       86       57       75       87
GRID          88         1   3.5000   0.0000   1.0000        1      456
GRID          89         1   3.5000  45.0000   1.0000        1      456
GRID          90         1   3.5000  90.0000   1.0000        1      456
CWEDGE        33        10       88       85       73       89       86       74
CWEDGE       133        10       89       86       74       90       87       75
CWEDGE        34        10       73       76       88       74       77       89
CWEDGE       134        10       74       77       89       75       78       90
GRID          91         1   3.5000   0.0000    .5000        1      456
GRID          92         1   3.5000  45.0000    .5000        1      456
GRID          93         1   3.5000  90.0000    .5000        1      456
CWEDGE        35        10       91       88       76       92       89       77
CWEDGE       135        10       92       89       77       93       90       78
CWEDGE        36        10       76       79       91       77       80       92
CWEDGE       136        10       77       80       92       78       81       93
GRID        1000         1    3.500    0.000    0.000        1      246
GRID        1001         1    3.500   45.000    0.000        1
GRID        1002         1    3.500   90.000    0.000        1      246
CWEDGE        37        10     1000       91       79     1001       92       80
CWEDGE       137        10     1001       92       80     1002       93       81
CWEDGE        38        10       79       82     1000       80       83     1001
CWEDGE       138        10       80       83     1001       81       84     1002
GRID          94         1   3.0000   0.0000   1.5000        1      456
GRID          95         1   3.0000  45.0000   1.5000        1      456
GRID          96         1   3.0000  90.0000   1.5000        1      456
CWEDGE        39        10       94       67       61       95       68       62
CWEDGE       139        10       95       68       62       96       69       63
CWEDGE        40        10       61       85       94       62       86       95
CWEDGE       140        10       62       86       95       63       87       96
GRID          97         1   3.0000   0.0000   1.0000        1      456
GRID          98         1   3.0000  45.0000   1.0000        1      456
GRID          99         1   3.0000  90.0000   1.0000        1      456
CWEDGE        41        10       97       94       85       98       95       86
CWEDGE       141        10       98       95       86       99       96       87
CWEDGE        42        10       85       88       97       86       89       98
CWEDGE       142        10       86       89       98       87       90       99
GRID         100         1   3.0000   0.0000    .5000        1      456
GRID         101         1   3.0000  45.0000    .5000        1      456
GRID         102         1   3.0000  90.0000    .5000        1      456
CWEDGE        43        10      100       97       88      101       98       89
```

```
CWEDGE     143      10     101      98      89     102      99      90
CWEDGE      44      10      88      91     100      89      92     101
CWEDGE     144      10      89      92     101      90      93     102
GRID       103       1   3.000   0.000   0.000       1    2456
GRID       104       1   3.000  45.000   0.000       1     456
GRID       105       1   3.000  90.000   0.000       1    2456
MPC          1      82       1   1.000    1000       1  -1.000
MPC          1     103       1   1.000    1000       1  -1.000
MPC          1      82       3   1.000    1000       5    .500       + 1
+ 1                1000       3  -1.000
MPC          1     103       3   1.000    1000       5   -.500       + 2
+ 2                1000       3  -1.000
MPC          1      83       1   1.000    1001       1  -1.000
MPC          1     104       1   1.000    1001       1  -1.000
MPC          1      83       2   1.000    1001       6   -.500       + 3
+ 3                1001       2  -1.000
MPC          1     104       2   1.000    1001       6    .500       + 4
+ 4                1001       2  -1.000
MPC          1      83       3   1.000    1001       5    .500       + 5
+ 5                1001       3  -1.000
MPC          1     104       3   1.000    1001       5   -.500       + 6
+ 6                1001       3  -1.000
MPC          1      84       1   1.000    1002       1  -1.000
MPC          1     105       1   1.000    1002       1  -1.000
MPC          1      84       3   1.000    1002       5    .500       + 7
+ 7                1002       3  -1.000
MPC          1     105       3   1.000    1002       5   -.500       + 8
+ 8                1002       3  -1.000
CWEDGE      45      10     103     100      91     104     101      92
CWEDGE     145      10     104     101      92     105     102      93
CWEDGE      46      10      91    1000     103      92    1001     104
CWEDGE     146      10      92    1001     104      93    1002     105
```

PROBLEM B-VIII

CURVED BOUNDARY

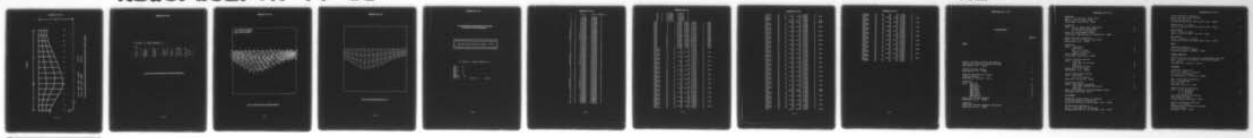
This problem illustrates the use of the curved boundary option. Figure B-49 shows the planned finite element model and configuration of a missile nozzle. The outer surface of the nozzle has a constant radius of 6.5 inches. The inner surface is represented by two third ordered curves. (see Figure B-49)

A complete listing of the data input is shown in Figure B-50. Figure B-51 shows the grid point and element identification numbers as generated by JIG. Figure B-52 gives the NASTRAN structural plot of the finite element model and is followed by a listing of the JIG punched output.

AD-A049 663 NAVAL SURFACE WEAPONS CENTER WHITE OAK LAB SILVER SP--ETC F/G 13/13
JUNCTION INPUT GENERATOR (JIG), A NASTRAN PRE-PROCESSOR; THEORE--ETC(U)
SEP 77 P C HUANG, K C KIDDY, J P MATRA

UNCLASSIFIED NSWC/WOL/TR-77-85 NL

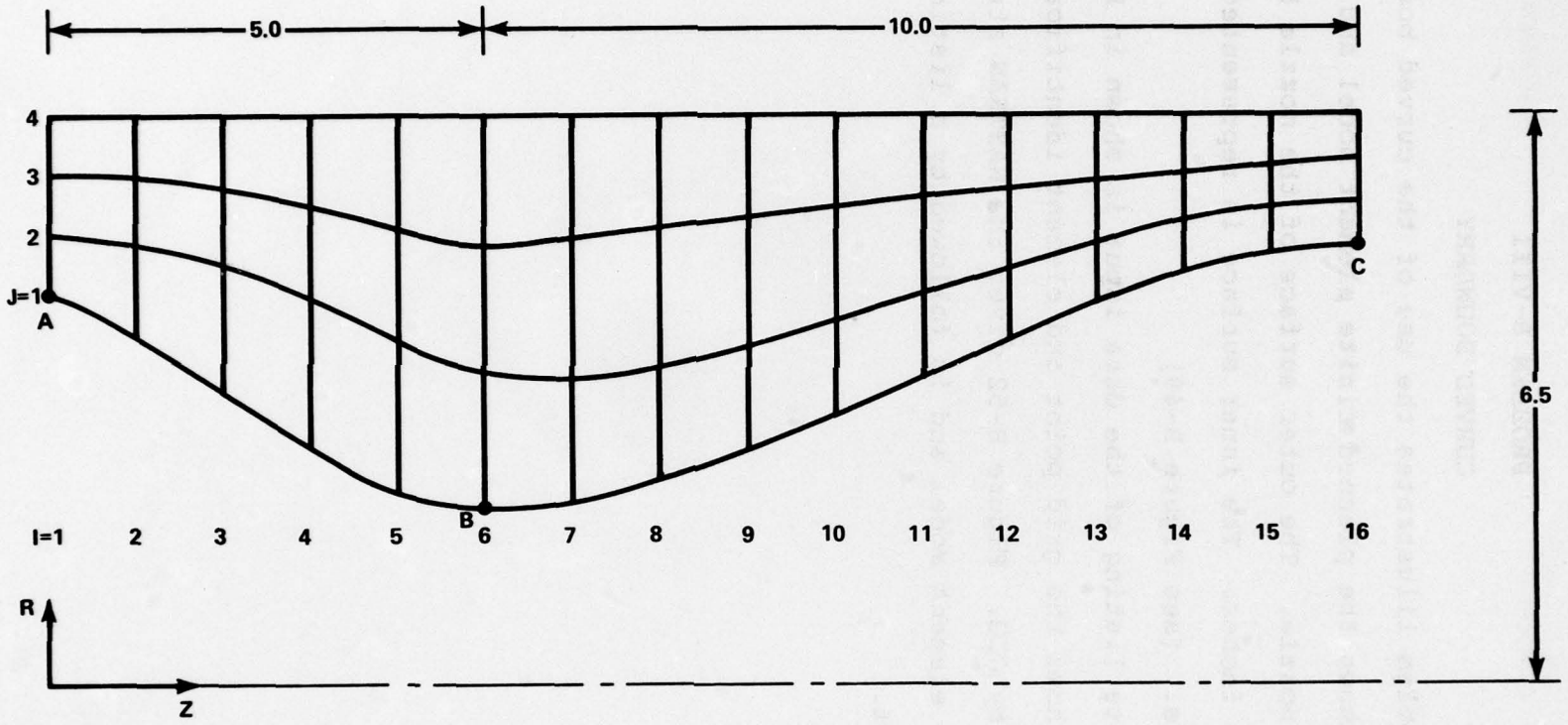
3 OF 3
AD
A049663





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DATE
FILMED
3-78
DDC

SAMPLE 8



$R = 4.5 - 0.375Z - 0.15Z^2 + 0.025Z^3$ $(A \leq Z \leq B)$

$R = 5.0 - 1.35Z + 0.18Z^2 - 0.006Z^3$ $(B \leq Z \leq C)$

FIG. B-49 PLANNED FINITE ELEMENT MODEL AND CONFIGURATION OF A MISSILE NOZZLE.

```
*** SAMPLE 8 - CURVED BOUNDARY ***
   1     1     1     1     5     0     0     0
   1
  0.0
   6     1     4     1    16     0     0     0     0     0 2456     0
   1     1   0.0          4.5          2     6     1     5.0          2.0          2
  4.5         -.375        -.15         .025        0.0          0.0          0.0
  16     1   15.0          5.0          1    16     4    15.0          6.5          1
  5.0       -1.35           .18        -.006        0.0          0.0          0.0
   6     4    5.0          6.5          1     1     4     0.0          6.5          1
```

FIG. B-50 DATA INPUT PROBLEM B-VIII CURVED BOUNDARY

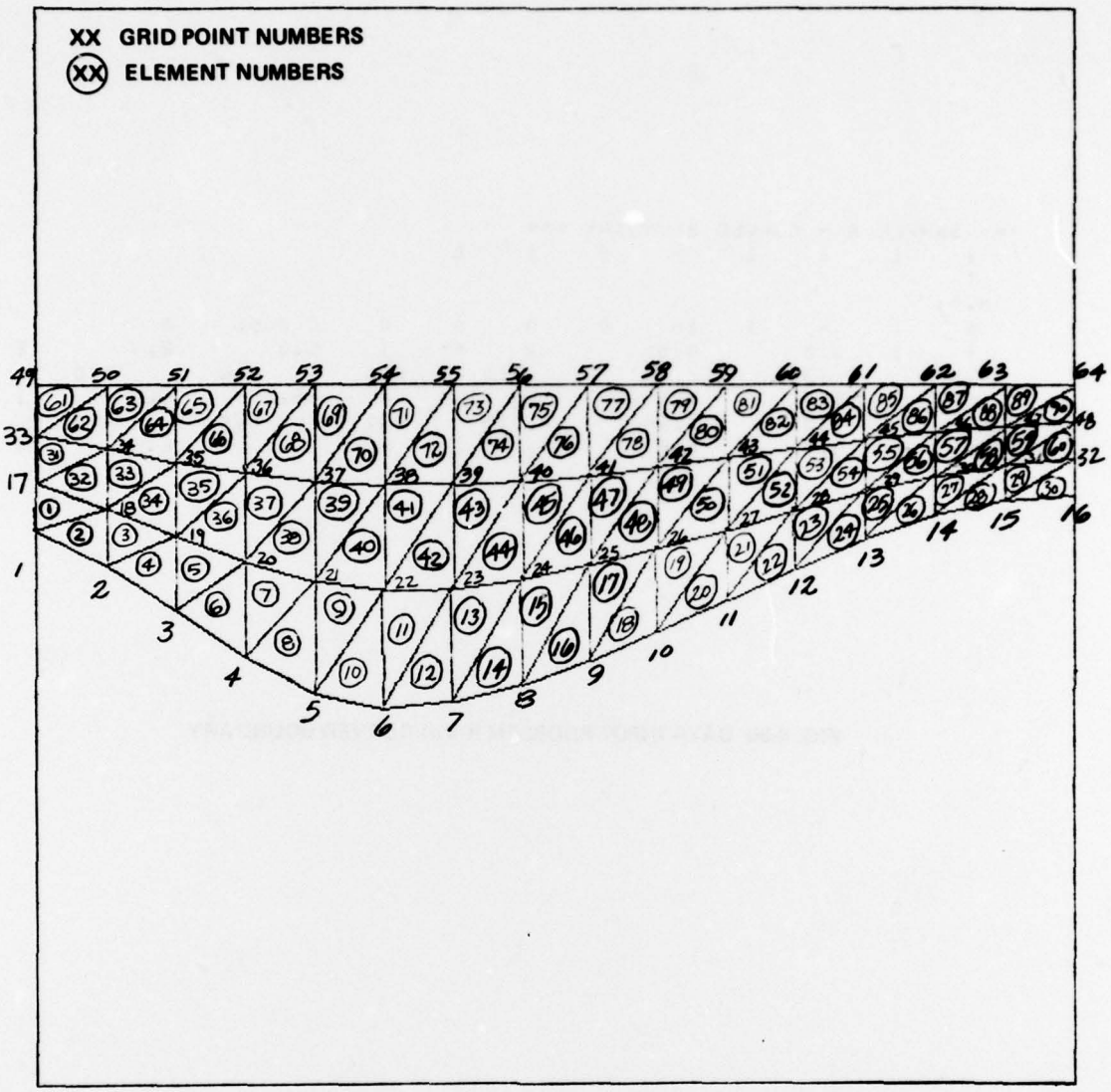


FIG. B-51 GRID POINT AND ELEMENT NUMBERS

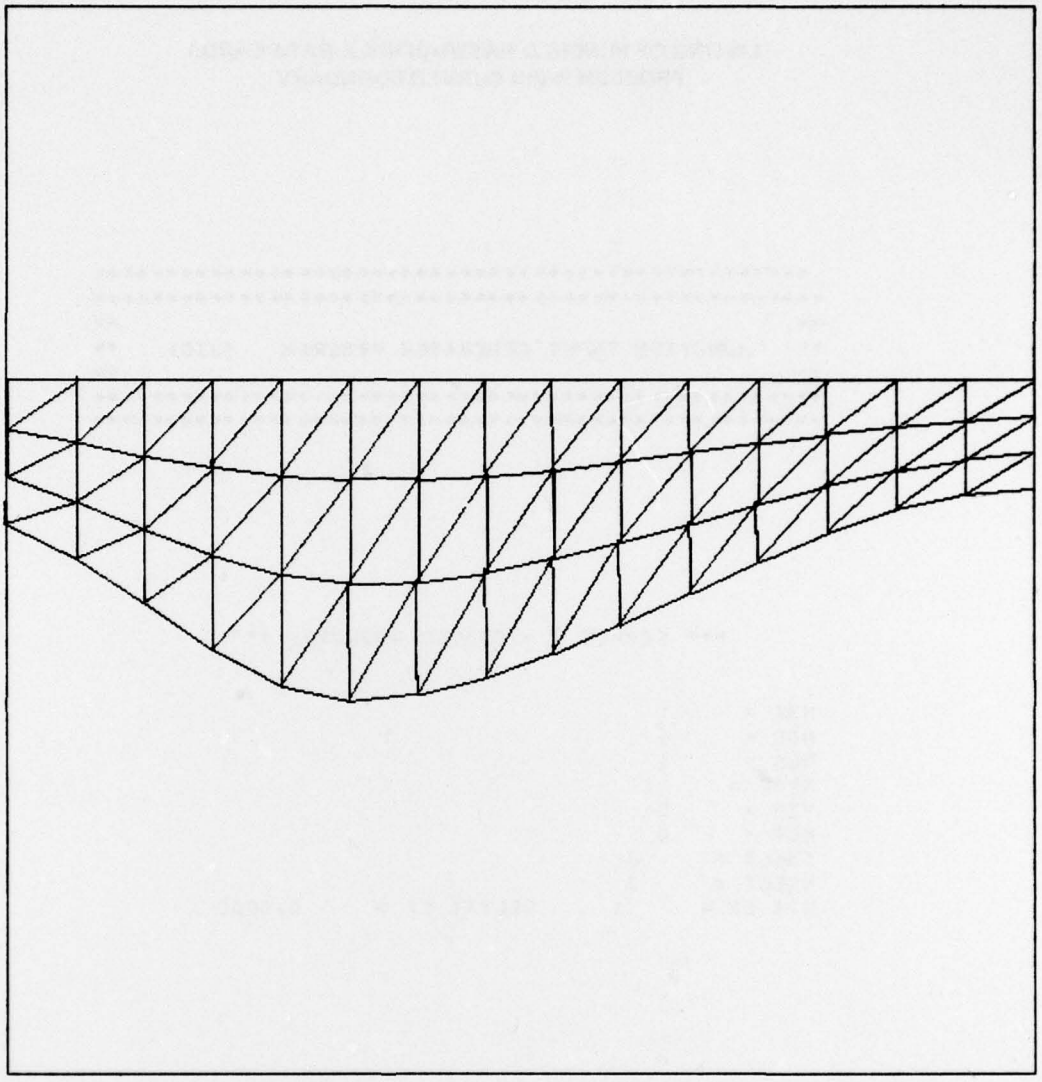


FIG. B-52 NASTRAN STRUCTURAL PLOT

LISTING OF PUNCHED NASTRAN BULK DATA CARDS
PROBLEM B-VIII CURVED BOUNDARY

```
**********************************************
**********************************************
**                                          **
**   JUNCTION INPUT GENERATOR PROGRAM  (JIG) **
**                                          **
**********************************************
**********************************************
```

*** SAMPLE 8 - CURVED BOUNDARY ***

```
NST =      1
NGS =      1
NES =      1
NPOP =     1
MID =      5
NGP =      0
IDELT =    0
NSECT =    0
NT( 1) =     1     DELTZ( 1) =     0.0000
```

I	J	Z(I,J)	X(I,J)	CODE(I,J)
1	1	0.00000	4.50000	1
2	1	1.00000	4.00000	1
3	1	2.00000	3.35000	1
4	1	3.00000	2.70000	1
5	1	4.00000	2.20000	1
6	1	5.00000	2.00000	1
7	1	6.00000	2.08400	1
8	1	7.00000	2.31200	1
9	1	8.00000	2.64800	1
10	1	9.00000	3.05600	1
11	1	10.00000	3.50000	1
12	1	11.00000	3.94400	1
13	1	12.00000	4.35200	1
14	1	13.00000	4.68800	1
15	1	14.00000	4.91600	1
16	1	15.00000	5.00000	1
1	2	0.00000	5.16667	1
2	2	1.00010	4.80871	0
3	2	2.00012	4.41625	0
4	2	3.00002	4.04117	0
5	2	4.00005	3.75669	0
6	2	5.00011	3.62439	0
7	2	6.00009	3.64463	0
8	2	7.00007	3.77120	0
9	2	8.00005	3.97329	0
10	2	9.00006	4.22474	0
11	2	10.00005	4.50092	0
12	2	11.00003	4.77801	0
13	2	12.00001	5.03313	0
14	2	13.00001	5.24558	0
15	2	14.00002	5.40047	0
16	2	15.00000	5.50000	1
1	3	0.00000	5.83333	1
2	3	1.00004	5.65176	0
3	3	1.99995	5.46491	0
4	3	2.99995	5.29179	0
5	3	4.00000	5.16115	0
6	3	5.00003	5.09611	0
7	3	6.00000	5.09888	0
8	3	6.99999	5.15481	0
9	3	8.00002	5.24921	0
10	3	9.00003	5.36872	0
11	3	10.00002	5.50090	0
12	3	11.00001	5.63397	0
13	3	12.00000	5.75695	0
14	3	13.00001	5.86071	0
15	3	14.00002	5.94030	0
16	3	15.00000	6.00000	1
1	4	0.00000	6.50000	1
2	4	1.00000	6.50000	1
3	4	2.00000	6.50000	1
4	4	3.00000	6.50000	1
5	4	4.00000	6.50000	1
6	4	5.00000	6.50000	1
7	4	6.00000	6.50000	1
8	4	7.00000	6.50000	1
9	4	8.00000	6.50000	1
10	4	9.00000	6.50000	1

```
   11     4     10.00000        6.500000      1
   12     4     11.00000        6.500000      1
   13     4     12.00000        6.500000      1
   14     4     13.00000        6.500000      1
   15     4     14.00000        6.500000      1
   16     4     15.00000        6.500000      1
GRID          1        0   4.5000  0.0000   0.0000        0      2456
GRID          2        0   4.0000  0.0000   1.0000        0      2456
GRID          3        0   3.3500  0.0000   2.0000        0      2456
GRID          4        0   2.7000  0.0000   3.0000        0      2456
GRID          5        0   2.2000  0.0000   4.0000        0      2456
GRID          6        0   2.0000  0.0000   5.0000        0      2456
GRID          7        0   2.0840  0.0000   6.0000        0      2456
GRID          8        0   2.3120  0.0000   7.0000        0      2456
GRID          9        0   2.6480  0.0000   8.0000        0      2456
GRID         10        0   3.0560  0.0000   9.0000        0      2456
GRID         11        0   3.5000  0.0000  10.0000        0      2456
GRID         12        0   3.9440  0.0000  11.0000        0      2456
GRID         13        0   4.3520  0.0000  12.0000        0      2456
GRID         14        0   4.6880  0.0000  13.0000        0      2456
GRID         15        0   4.9160  0.0000  14.0000        0      2456
GRID         16        0   5.0000  0.0000  15.0000        0      2456
GRID         17        0   5.1667  0.0000   0.0000        0      2456
GRID         18        0   4.8087  0.0000   1.0001        0      2456
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CTRIARG       2        1        2      18   0.0000        5
GRID         19        0   4.4162  0.0000   2.0001        0      2456
CTRIARG       3       19       18       2   0.0000        5
CTRIARG       4        2        3      19   0.0000        5
GRID         20        0   4.0412  0.0000   3.0000        0      2456
CTRIARG       5       20       19       3   0.0000        5
CTRIARG       6        3        4      20   0.0000        5
GRID         21        0   3.7567  0.0000   4.0001        0      2456
CTRIARG       7       21       20       4   0.0000        5
CTRIARG       8        4        5      21   0.0000        5
GRID         22        0   3.6244  0.0000   5.0001        0      2456
CTRIARG       9       22       21       5   0.0000        5
CTRIARG      10        5        6      22   0.0000        5
GRID         23        0   3.6446  0.0000   6.0001        0      2456
CTRIARG      11       23       22       6   0.0000        5
CTRIARG      12        6        7      23   0.0000        5
GRID         24        0   3.7712  0.0000   7.0001        0      2456
CTRIARG      13       24       23       7   0.0000        5
CTRIARG      14        7        8      24   0.0000        5
GRID         25        0   3.9733  0.0000   8.0001        0      2456
CTRIARG      15       25       24       8   0.0000        5
CTRIARG      16        8        9      25   0.0000        5
GRID         26        0   4.2247  0.0000   9.0001        0      2456
CTRIARG      17       26       25       9   0.0000        5
CTRIARG      18        9       10      26   0.0000        5
GRID         27        0   4.5009  0.0000  10.0001        0      2456
CTRIARG      19       27       26      10   0.0000        5
CTRIARG      20       10       11      27   0.0000        5
GRID         28        0   4.7780  0.0000  11.0000        0      2456
CTRIARG      21       28       27      11   0.0000        5
CTRIARG      22       11       12      28   0.0000        5
GRID         29        0   5.0331  0.0000  12.0000        0      2456
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CTRIARG      24       12       13      29   0.0000        5
GRID         30        0   5.2456  0.0000  13.0000        0      2456
CTRIARG      25       30       29      13   0.0000        5
CTRIARG      26       13       14      30   0.0000        5
GRID         31        0   5.4085  0.0000  14.0000        0      2456
CTRIARG      27       31       30      14   0.0000        5
```

```
CTRIARG        28        14        15        31   0.0000        5
GRID           32         0    5.5000    0.0000  15.0000        0        2456
CTRIARG        29        32        31        15   0.0000        5
CTRIARG        30        15        16        32   0.0000        5
GRID           33         0    5.8333    0.0000   0.0000        0        2456
GRID           34         0    5.6518    0.0000   1.0000        0        2456
CTRIARG        31        34        33        17   0.0000        5
CTRIARG        32        17        18        34   0.0000        5
GRID           35         0    5.4649    0.0000   2.0000        0        2456
CTRIARG        33        35        34        18   0.0000        5
CTRIARG        34        18        19        35   0.0000        5
GRID           36         0    5.2918    0.0000   2.9999        0        2456
CTRIARG        35        36        35        19   0.0000        5
CTRIARG        36        19        20        36   0.0000        5
GRID           37         0    5.1611    0.0000   4.0000        0        2456
CTRIARG        37        37        36        20   0.0000        5
CTRIARG        38        20        21        37   0.0000        5
GRID           38         0    5.0961    0.0000   5.0000        0        2456
CTRIARG        39        38        37        21   0.0000        5
CTRIARG        40        21        22        38   0.0000        5
GRID           39         0    5.0989    0.0000   6.0000        0        2456
CTRIARG        41        39        38        22   0.0000        5
CTRIARG        42        22        23        39   0.0000        5
GRID           40         0    5.1548    0.0000   7.0000        0        2456
CTRIARG        43        40        39        23   0.0000        5
CTRIARG        44        23        24        40   0.0000        5
GRID           41         0    5.2492    0.0000   8.0000        0        2456
CTRIARG        45        41        40        24   0.0000        5
CTRIARG        46        24        25        41   0.0000        5
GRID           42         0    5.3687    0.0000   9.0000        0        2456
CTRIARG        47        42        41        25   0.0000        5
CTRIARG        48        25        26        42   0.0000        5
GRID           43         0    5.5009    0.0000  10.0000        0        2456
CTRIARG        49        43        42        26   0.0000        5
CTRIARG        50        26        27        43   0.0000        5
GRID           44         0    5.6340    0.0000  11.0000        0        2456
CTRIARG        51        44        43        27   0.0000        5
CTRIARG        52        27        28        44   0.0000        5
GRID           45         0    5.7570    0.0000  12.0000        0        2456
CTRIARG        53        45        44        28   0.0000        5
CTRIARG        54        28        29        45   0.0000        5
GRID           46         0    5.8607    0.0000  13.0000        0        2456
CTRIARG        55        46        45        29   0.0000        5
CTRIARG        56        29        30        46   0.0000        5
GRID           47         0    5.9403    0.0000  14.0000        0        2456
CTRIARG        57        47        46        30   0.0000        5
CTRIARG        58        30        31        47   0.0000        5
GRID           48         0    6.0000    0.0000  15.0000        0        2456
CTRIARG        59        48        47        31   0.0000        5
CTRIARG        60        31        32        48   0.0000        5
GRID           49         0    6.5000    0.0000   0.0000        0        2456
GRID           50         0    6.5000    0.0000   1.0000        0        2456
CTRIARG        61        50        49        33   0.0000        5
CTRIARG        62        33        34        50   0.0000        5
GRID           51         0    6.5000    0.0000   2.0000        0        2456
CTRIARG        63        51        50        34   0.0000        5
CTRIARG        64        34        35        51   0.0000        5
GRID           52         0    6.5000    0.0000   3.0000        0        2456
CTRIARG        65        52        51        35   0.0000        5
CTRIARG        66        35        36        52   0.0000        5
GRID           53         0    6.5000    0.0000   4.0000        0        2456
CTRIARG        67        53        52        36   0.0000        5
CTRIARG        68        36        37        53   0.0000        5
GRID           54         0    6.5000    0.0000   5.0000        0        2456
```

```
CTRIARG         69      54      53      37  0.0000      5
CTRIARG         70      37      38      54  0.0000      5
GRID            55       0  6.5000  0.0000  6.0000      0    2456
CTRIARG         71      55      54      38  0.0000      5
CTRIARG         72      38      39      55  0.0000      5
GRID            56       0  6.5000  0.0000  7.0000      0    2456
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CTRIARG         74      39      40      56  0.0000      5
GRID            57       0  6.5000  0.0000  8.0000      0    2456
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CTRIARG         76      40      41      57  0.0000      5
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CTRIARG         77      58      57      41  0.0000      5
CTRIARG         78      41      42      58  0.0000      5
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CTRIARG         82      43      44      60  0.0000      5
GRID            61       0  6.5000  0.0000 12.0000      0    2456
CTRIARG         83      61      60      44  0.0000      5
CTRIARG         84      44      45      61  0.0000      5
GRID            62       0  6.5000  0.0000 13.0000      0    2456
CTRIARG         85      62      61      45  0.0000      5
CTRIARG         86      45      46      62  0.0000      5
GRID            63       0  6.5000  0.0000 14.0000      0    2456
CTRIARG         87      63      62      46  0.0000      5
CTRIARG         88      46      47      63  0.0000      5
GRID            64       0  6.5000  0.0000 15.0000      0    2456
CTRIARG         89      64      63      47  0.0000      5
CTRIARG         90      47      48      64  0.0000      5
```

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